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1. Safety Messages

For the best results with the E-100 Series inverter, read this manual and all of the warning labels attached to the inverter carefully before installing and operating it, and follow the instructions exactly. Keep this manual handy for quick reference.

Definitions and Symbols

A safety instruction(message) includes a hazard alert symbol and a signal word, DANGER or CAUTION. Each signal word has the following meaning:

This symbol is the "Safety Alert Symbol." It occurs with either of two signal words : DANGER or CAUTION, as described below

DANGER : Indicates a potentially hazardous situation which, if not avoided, can result in serious injury or death.

CAUTION : Indicates a potentially hazardous situation which, if not avoided, can result in minor to moderate injury, or serious damage to the product. The situation described in the **CAUTION** may, if not avoided, lead to serious results. Important safety measures are described in CAUTION (as well as DANGER), so be sure to observe them.

NOTE : Notes indicate an area or subject of special merit, emphasizing either the product's capabilities or common errors in operation or maintenance.

⚠ CAUTION

¡Some drawings in this manual are shown with the protective or shields removed in order to describe detail with more clarity. Make sure all covers and shields are replaced before operating this product.

¡This manual may be modified when necessary because of the improvement of the product, modification, or changes in specifications.

¡To order a copy of this manual, or if your copy has been damaged or lost, contact your ENDA representative.

¡ENDA is not responsible for any modification of the product made by the user, since that will void the guarantee.

Index to Dangers and Cautions in This Manual

Installation-cautions for Mounting Procedures

⚠ CAUTION

¡Be sure to install the unit on flame-resistant material such as a steel plate. Otherwise, there is the danger of fire. ····· 5-1

¡Be sure not to place any flammable materials near the inverter. Otherwise, there is the danger of fire. ····· 5-1

¡Be sure not to let the foreign object enter vent openings in the inverter housing, such as wire clippings, spatter from welding, metal shavings, dust, etc. Otherwise, there is the danger of fire. ····· 5-1

¡Be sure to install the inverter in a place which can bear the weight according to the specifications in the text. Otherwise, it may fall and cause injury to personnel. ····· 5-1

¡Be sure to install the unit on a perpendicular wall which is not subject to vibration. Otherwise, it may fall and cause injury to personnel. ····· 5-1

¡Be sure not to install or operate an inverter which is damaged or has missing parts. Otherwise, it may cause injury to personnel. ····· 5-1

¡Lift the cabinet by the cooling fin. When moving the unit, never lift by the plastic case or the terminal covers. Otherwise, the main unit may be dropped causing damage to the unit. ····· 5-1

¡When mounting units in an enclosure, install a fan or other cooling device to keep the intake air temperature below 40¡. ····· 5-1

⚠ CAUTION

¡Be sure to maintain the specified clearance area around the inverter and to provide adequate ventilation.
Otherwise, the inverter may overheat and cause equipment damage or fire. ····· 5-2

¡Be sure to install the inverter in a well-ventilated room which does not have direct exposure to sunlight, a tendency for high temperature, high humidity of dew condensation, high levels of dust, corrosive gas, explosive gas, inflammable gas, grinding-fluid mist, salt damage, etc.
Otherwise, there is the danger of fire. ····· 5-2

Wiring-Dangers for Electrical Practices and Wire Specifications

⚠ DANGER

- Be sure to connect grounding terminal. ····· 6-2
  Otherwise, there is a danger of electric shock and/or fire.

- Wiring work shall be carried out only by qualified personnel. ····· 6-2
  Otherwise, there is a danger of electric shock and/or fire.

- Implement wiring after checking that the power supply is off. You may incur electric shock and/or fire. ····· 6-2

- Do not connect wiring to an inverter or operate an inverter that is not mounted according the instructions given in this manual. ····· 6-2
  Otherwise, there is a danger of electric shock and/or injury to personnel.

- When wiring the emergency stop circuit, check the wiring thoroughly before operation. ····· 6-2
  Otherwise, it may cause injury to personnel.

Wiring-Cautions for Electrical Practices

⚠ CAUTION

¡Be sure that the input voltage matches the inverter specifications: ····· 6-1
¡Single-phase 200 to 230 V 50/60Hz
Otherwise, there is the danger of injury and/or fire.

¡Be sure not to connect an AC power supply to the output terminals(U.V.W). ····· 6-1
Otherwise, there is the danger of injury and/or fire.

¡Do not Run/Stop operation by switching ON/OFF electromagnetic contactors on the primary or secondary sides of the inverter. ····· 6-1
Otherwise, there is the danger of fire.

¡To connect a braking resistor, follow the procedures described in this manual. ····· 6-1
Otherwise, there is the danger of fire.

⚠ CAUTION

¡Fasten the screws with the specified fastening torque. Check for any loosening of screws. Otherwise, there is the danger of fire. ····· 6-1

¡Be sure to install a fuse in the wire for each phase of the main power supply to the inverter. Otherwise, there is the danger of fire. ····· 6-1

¡Do not perform a withstand voltage test of the inverter. Otherwise, it may cause semi-conductor elements to be damaged. ····· 6-1

¡To connect a braking resistor, braking resistor unit or braking unit, follow the procedures in this manual. Improper connection may cause a fire. ····· 6-1

¡Do not connect or disconnect wires or connectors while power is applied to the circuit. Otherwise, it may cause injury to personnel. ····· 6-1

Dangers for Operations and Monitoring

⚠ DANGER

¡Be sure to turn on the input power supply after closing the main case. While being energized, be sure not to open the main case.
Otherwise, there is the danger of electric shock and/or fire. ····· 7-1

¡Be sure not to operate the switches with wet hands.
Otherwise, there is the danger of electric shock. ····· 7-1

¡While the inverter is energized, be sure not to touch the inverter terminals even when the motor is stopped.
Otherwise, there is the danger of electric shock. ····· 7-1

¡If the Retry Mode is selected, the motor may suddenly restart during the trip reset Do not approach the machine(be sure to design the machine so that safety for personnel is secure even if it restarts.)
Otherwise, it may cause injury to personnel and/or fire. ····· 7-1

¡If the power supply is cut off for a short period of time, the inverter may restart operation after the power supply recovers if the command to operate is active.
If a restart may pose danger to personnel, so be sure to use a lock out circuit so that it will not restart after power recovery.
Otherwise, it may cause injury to personnel. ····· 7-1

¡The Stop Key is effective only when the stop function is enabled. Be sure to prepare emergency stop key separately.
Otherwise, it may cause injury to personnel. ····· 7-1

⚠ DANGER

¡After the operation command is given, if the alarm reset is conducted, it will restart suddenly. Be sure to set the alarm reset after verifying the operation command is off. Otherwise, it may cause injury to personnel. ····· 7-1

¡Be sure not to touch the inside of the energized inverter or to put any conductive object into it. Otherwise, there is a danger of electric shock and/of fire. ····· 7-1

Cautions for Operations and Monitoring

⚠ CAUTION

¡The heat sink fins will have a high temperature. ····· 7-2
Be careful not to touch them.
Otherwise, there is the danger of getting burned.

¡Install a holding brake separately if necessary. ····· 7-2
Otherwise, there is the danger of accident.

¡Check the direction of the motor, any abnormal ····· 7-2
motor vibrations or noise.
Otherwise, there is the danger of equipment damage.

¡The operation of the inverter can be easily changed ····· 7-2
from low speed to high speed. Be sure check the
capability and limitation of the motor and machine
before operating the inverter.

¡If you operate a motor at a frequency higher than ····· 7-2
the inverter standard default setting (60Hz), be sure
to check the motor and machine specifications with
the respective manufacturer. Only operate the motor at
elevated frequencies after getting their approval.
Otherwise, there is the danger of equipment damage.

¡All the constants of the inverter have been preset ····· 7-2
at the factory.
Otherwise, there is the danger of equipment damage.

Dangers and cautions for Troubleshooting Inspection and Maintenance

⚠ DANGER

¡Wait at least five(5) minutes after turning off the input power supply before performing maintenance or an inspection.
Otherwise, there is the danger of electric shock. ····· 12-1

¡Make sure that only qualified personnel will perform maintenance, inspection, and part replacement. ····· 12-1
(Before starting to work, remove any metallic objects from your person(wrist watch, bracelet, etc.) Be sure to use tools with insulated handles.
Otherwise, there is a danger of electric shock and/or injury to personnel.

¡Never touch high-voltage terminals in the inverter. ····· 12-1
Otherwise, there is a danger of electric shock.

¡The logic PCB employs CMOS ICs. ····· 12-1
Do not touch the CMOS elements.
They are easily damaged by static electricity.

¡Do not connect or disconnect wires, connectors, or cooling fan while power is applied to the circuit. ····· 12-1
Otherwise, it may cause injury to personnel.

Dangers for using

⚠ DANGER

¡Never modify the product.
Otherwise, there is a danger of electric shock and/or injury to personnel.

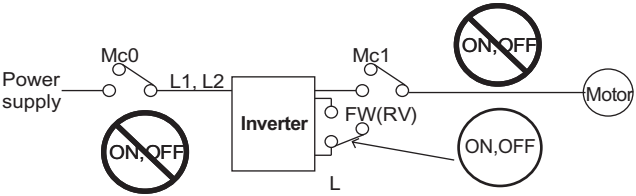
WARNING DISPLAY

⚠ WARNING
⚠ DANGER

¡Risk of electric shock.
¡Ensure proper earth connection.
¡Refer to the user's manual before installation and operation.

A warning label is displayed on the main cover of the inverter, as shown in the figure.
Follow these instructions when handling the inverter.

Note1) Do not Run/Stop operation by switching on/off electromagnetic contactors (Mc0, Mc1) on the primary or secondary sides of the inverter.
Operate the inverter by Run/Stop commanding [FW/RV].



Note 2) Motor Terminal Surge Voltage Suppression Filter
In a system using an inverter with the voltage control PWM system, a voltage surge caused by the cable constants such as the cable length (especially when the distance between the motor and inverter is 10m or more) and cabling method may occur at the motor terminals.

Note 3) Input power disconnection
This inverter is not able to protect input power disconnection.
Be careful to connect the wires.

Note 4) In the cases below involving a general-purpose inverter, a large peak current flows on the power supply side, sometimes destroying the converter module.

¡The unbalance factor of the power supply is 3% or higher.

¡The power supply capacity is at least 10 times greater than the inverter capacity(and the power supply capacity, 500kVA or more).

¡Abrupt power supply changes are expected.

some examples) Several inverters are interconnected with a short bus.
An installed leading capacitor opens and closes.

Note 5) RC Value of the thermal Relay is 1.1 times greater than the motor rated current. Also, RC Value is adjustable to the wiring distance, but contacts us in this case.

Note 6) Do not connect and disconnect the power supply more than 1/5(minute / number)
There is the danger of inverter damage.

Note 7) When the EEPROM error E 08 occurs, be sure to confirm the setting values again.

2. Receiving and checking

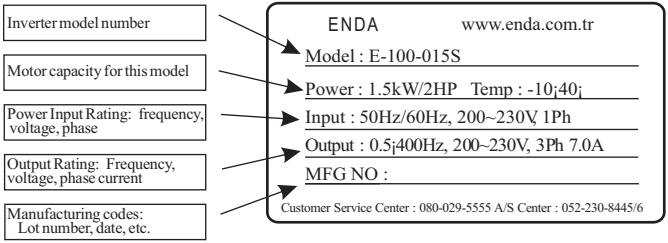
Inverter Specifications Label

Before installing and wiring, check the following

(1) Check the unit for physical damage that may have occurred during shipping

(2) Verify that the package contains one inverter and one manual after packing the E-100 inverter.

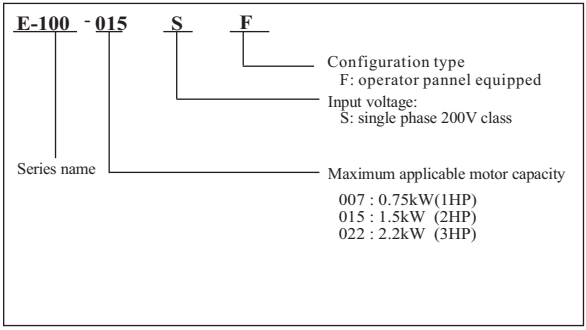
(3) Verify that the specifications on the labels match your purchase order



If any part of E-100 is missing or damaged, call for service immediately

Model Number convention

The model number for a specific inverter contains useful information about its operating characteristics. Refer to the model number legend below:



3. E-100 Inverter Standard Specifications.

Model-specific tables

The standard specifications of E-100 inverter is as follows;

Item		Sing-phase 200V Class		
Model E-100 series		E-100 -007S	E-100 -015S	E-100 -022S
Applicable motor size *2	kW	0.75	1.5	2.2
	HP	1	2	3
Rated capacity(200V)kVA		1.9	3.0	4.2
Rated input voltage		Single-phase 200 to 230V ¡10%, 50/60 Hz ¡5%		
Rated output voltage *3		3-phase 200 to 230V (corresponding to input voltage)		
Rated output current(A)		5.0	7.0	10.0
Starting torque (with sensorless vector control)		200% or more		
Dynamic braking approx. % torque, (short time stop) *5	with resistor, from 50/60Hz	approximately 100%		
	without resistor	approximately 150%		
DC braking		Variable operating frequency, time and braking force		
Weight (kg)		1.1	1.2	1.2

General Specifications

The following table applies to all E-100 inverters.

Item			General Specifications
Protective housing *1			Enclosed type(IP20)
Control method *6			Space vector PWM control
Output frequency range *4			0.01 to 400Hz
Frequency accuracy			Digital command : ¡0.01% of the maximum frequency Analog command : ¡0.1% of the maximum frequency
Frequency setting resolution			Digital : 0.01Hz(100Hz and less), 0.1Hz (100Hz or more) Analog : Max. Setting frequency/ 500(DC 5V input), max. setting frequency/ 1000(DC 10V, 4¡20mA)
Volt./ Freq. Characteristic			Any base freguency setting possible between 0Hz and 400Hz. V/F control (constant torque, reduced torque).
Overload current rating			150%, 60 seconds
Acceleration/deceleration time			0.1 to 3000sec., (linear accel. / decel. s-curve, u-curve) second accel. / decel. setting available
Input signal	Freq-setting	Operator panel	Up and Down keys / Value settings
		Potentiometer	Analog setting via potentiometer
		External signal	1W, 1§ to 2§ variable resistor DC 0¡5V, DC 0¡10V(Input Impedonce 700§) 4¡20mA(Input Impedonce 25§)
	FWD/ REV Run	Operator panel	Run/Stop(Forward/Reverse run change by command)
		External signal	Forward run/stop, Reverse run/stop set by terminal assignment (NC/NO)
	Intelligent input terminal		FW(forward run command), RV(reverse run command), CF1¡CF4(multistage speed setting), JG(jog command), 2CH(2-stage accel./decel. command), FRS(free run stop command), EXT(external trip), USP (unattended startup), SFT(soft lock), AT(analog current input select signal), RS(reset), SET(2nd setting selection)

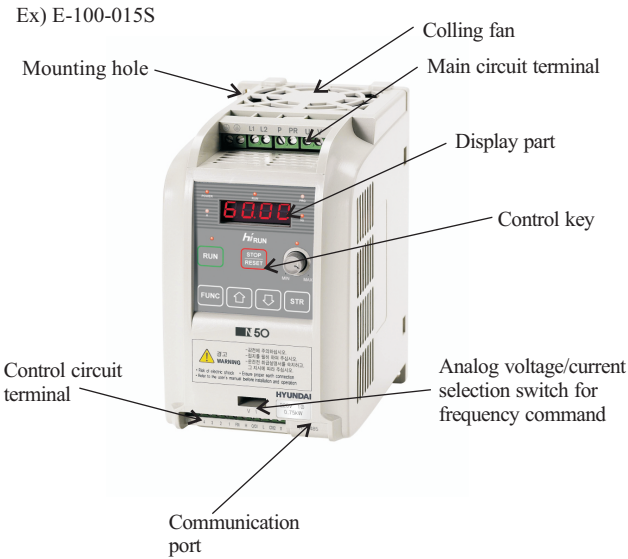
Item		General Specifications
Output signal	Intelligent output terminal	RUN(run status signal), FA1 (frequency arrival signal), FA2 (setting Frequency arrival signal), OL(overload advance notice signal), OD(PID error deviation signal), AL(alarm signal)
	Frequency monitor	Analog meter (DC0¡10V full scale, Max. 1mA) Analog output frequency, Analog output current and Analog output voltage signals selectable.
Other functions		AVR function, curved accel./decel. profile, upper and lower limiters, 16-stage speed profile, fine adjustment of start frequency, carrier frequency change (0.5 to 16Khz), frequency jump, gain and bias setting, process jogging, electronic thermal level adjustment, retry function, trip history monitor, 2nd setting selection, auto tuning, V/f characteristic selection, automatic torque boost, frequency coversion display, USP function
Protective function		Over-current, over-voltage, under-voltage, overload, extreme high/low temperature, internal communication error, external trip, EEPROM error, USP error, instantaneous power failure, output short-circuit detection.
Operating Environment	Ambient temperature	-10 to 40¡
	Storage temperature	-20¡¡60¡(short-term temperature during transport)
	Ambient humidity	90% RH or less (no condensing)
	Vibration	5.9m/s^2 (0.5G), 10 to 55Hz(conforms to the test method specified in JIS C0911)
	Location	Altitude 1,000m or less, indoors(no corrosive gasses or dust)
Options		Remote operator unit, cable for operator, braking unit, braking resistor, AC reactor, DC reactor, noise filter.

Footnotes for the preceding tables :

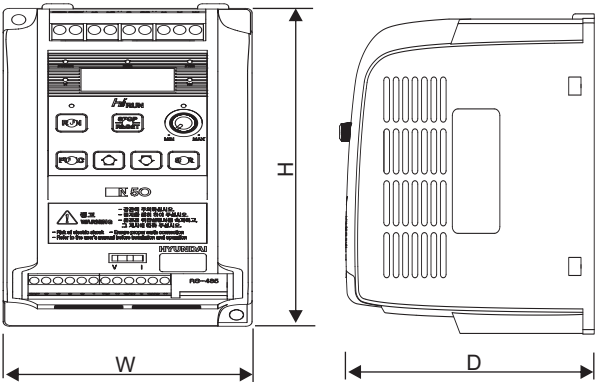
1. The protection method conforms to JEM 1030.
2. The applicable motor refers to ENDA standard 3-phase motor (4-pole). To use other motors, care must be taken to prevent the rated motor current(50/60Hz) from exceeding the rated output current of the inverter.
3. The output voltage decreases as the main supply voltage decreases (except for use of the AVR function). In any case, the output voltage cannot exceed the input power supply voltage.
4. To operate the motor beyond 50/60Hz, consult the motor mamanufacturer about the maximum allowable rotation speed.
5. The braking torque via capacitive feedback is the average decelection torque at the shortest deceleration (stopping from 50/60Hz as indicated). It is not continuous regenerative braking torque. And, the average deceleration torque varies with motor loss. This value decreases when operating beyond 50 Hz. If a large regenerative torque is required, the optional regenerative braking resistor should be used.
6. Control method setting A31 to 2 (sensorless vector control) Selected, set carrier frequency setting b11 more than 2.1kHz.

4. External Dimension Diagrams and Identifying the parts

Main Physical Features



Inverter Dimensions for Mounting



External Dimension			
Type	W	H	D
007SF	80	142	135
015S, 022S	95	142	135

5. Installation

Choosing a Mounting Location

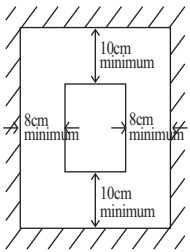
⚠ CAUTION

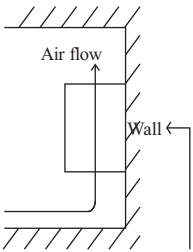
¡Be sure to install the unit on flame-resistant material such as a steel plate.
Otherwise, there is the danger of fire.
¡Be sure not to place any flammable materials near the inverter.
Otherwise, there is the danger of fire.
¡Be sure not to let the foreign object enter vent openings in the inverter housing, such as wire clippings, spatter from welding, metal shaving, dust, etc.
Otherwise, there is the danger of fire.
¡Be sure to install the inverter in a place which can bear the weight according to the specifications in the text
Otherwise, it may fall and cause injury to personnel.

⚠ CAUTION

¡Be sure to install the unit on a perpendicular wall which is not subject to vibration.
Otherwise, it may fall and cause injury to personnel.
¡Be sure not to install or operate an inverter which is damaged or has missing parts.
Otherwise, there is the danger of fire.
¡Be sure to install the inverter in a well-ventilated room which does not have direct exposure to sunlight, a tendency for high temperature, high humidity or dew condensation, high levels of dust, corrosive gas, explosive gas, inflammable gas, grinding fluid mist, salt damage, etc.
Otherwise, there is the danger of fire.

To summarize the cautions messages-You will need to find a solid, non-flammable, vertical surface that is a relaticely clean and any envirnment. In order to ensure enough room for air circulation around the inverter to aid in cooling, maintain the specified clearance around the inverter specified in the diagram.





⚠ CAUTION

Solid, nonflammable, vertical surface

Before proceeding to the wiring section, it's good time to temporarily cover the inverter's ventilation openings. It will prevent harmful debris such as wire clippings and metal shavings from entering the inverter during installation

⚠ CAUTION

The ambient temperature must be in the range of -10 to 40¡.

6.Wiring

⚠ DANGER

¡Be sure to ground the unit.
Otherwise, there is a danger of electric shock and/or fire.

¡Wiring work shall be carried out only by qualified personnel.
Otherwise, there is a danger of electric shock and/or fire.

¡Implement wiring after checking that the power supply is off.
You may incur electric shock and/or fire.

¡Do not connect wiring to an inverter or operate an inverter that is not mounted according the instructions given in this manual.
Otherwise, there is a danger of electric shock and/or injury to personnel.

⚠ CAUTION

¡Be sure to that input voltage matches the inverter specifications.
Otherwise, there is a danger of electric fire and/or injury to personnel.

¡Be sure not to connect an AC power supply to the output terminals.
Otherwise, there is a danger of electric fire and/or injury to personnel.

¡Be sure not to connect a resistor to the DC-link terminal(P, PB).
Otherwise, there is a danger of fire

¡Remarks for using earth leakage circuit breakers in the main supply.
Otherwise, there is a danger of fire.

¡For motor leads, earth leakage breakers and electromagnetic contactors, be sure to size these components properly.
Otherwise, there is a danger of fire.

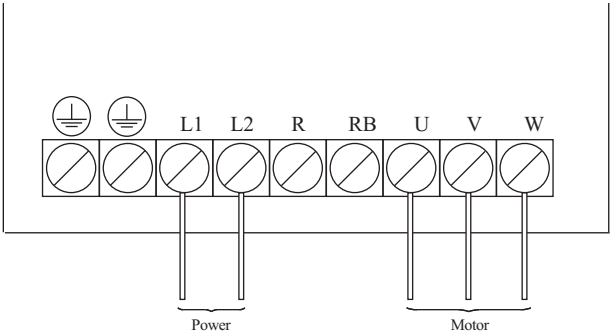
¡Do not RUN/STOP operation by switching ON/OFF electromagnetic contactors on the primary or secondary sides of the inverter.
Otherwise, there is a danger of fire.

¡Fasten the screws with the specified fastening torque.
Otherwise, there is a danger of fire.

6.1 Wiring the main circuit

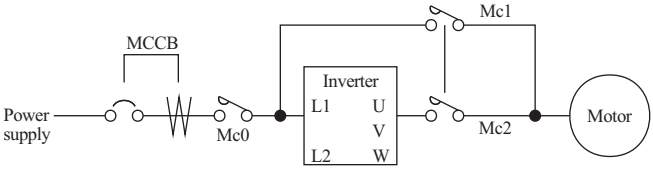
You will connect main circuit terminal wiring to the input of the inverter.

- N50-015S



¡Always connect the power input terminals L1, L2 to the power supply.
¡Be sure to install thermal relay individually when one inverter operates several motors.
¡Never connect P, RB, to R, S, T, or U, V, W.
Otherwise, there is the danger of equipment damage.

NOTE1) Install mechanically interlocked switches Mc1 and Mc2 in case of exchange by using commercial power supply and inverter.

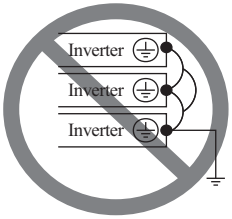


NOTE2) Install an earth leakage breaker(or MCCB) on the power supply side of the inverter. If the wiring distance between inverter and motor (10m and more) is long, the thermal relay may be incorrectly operated on the effect of high-frequency noise. Install the AC reactor on the inverter output side or use the current sensor.

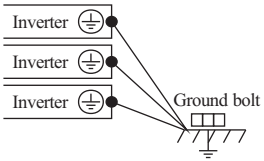
NOTE3) Make sure to ground the ground terminal according to the local grounding code. Never ground the E-100 inverter in common with welding machines, motors, or other electrical equipment.

When several inverters are used side by side, ground each unit as shown in examples. Do not the ground wires.

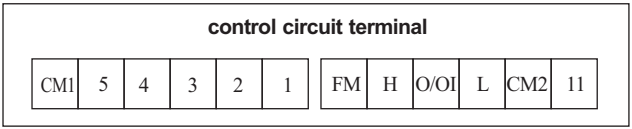
POOR



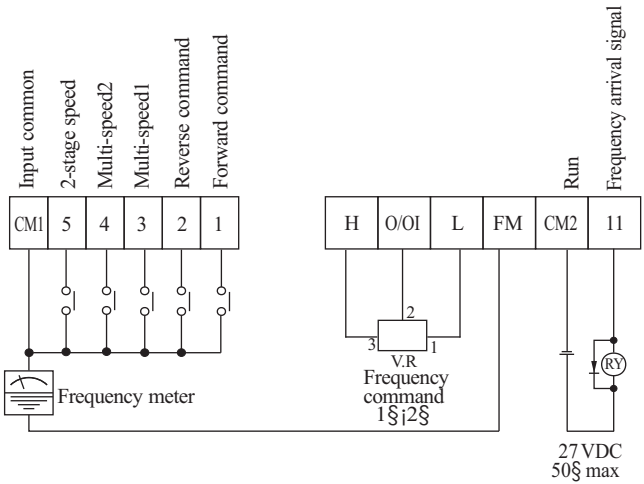
GOOD



6.2 Wiring the control circuit

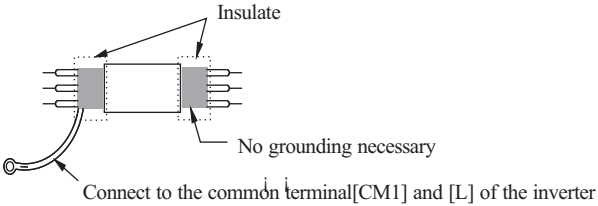


¡Example of control circuit terminal



Note1) When an output intelligent terminal is used, be sure to install a surge absorbing diode in parallel with relay. Otherwise, the surge voltage created when the relay goes ON or OFF may damage the output intelligent terminal circuit.

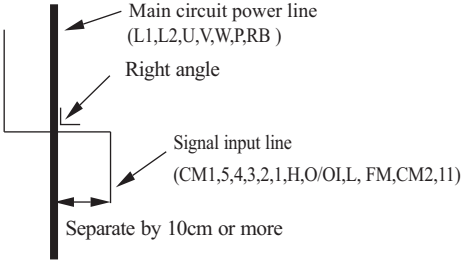
Note2) Use a twisted and shielded wire for the signal line, and cut the shielded covering as shown in the diagram below. Make sure that the length of the signal line is 20 meters or less



Note3) When the frequency setting signal is turned on and off with a contact, use a relay which will not cause contact malfunctions, even with the extremely weak currents and voltages.

Note4) Use relays which do not have contact defects at 24 V DC, 3mA for the other terminals.

Note5) Separate the main circuit wiring from the relay control circuit wiring. If they must cross, be sure that they cross at a right angle.



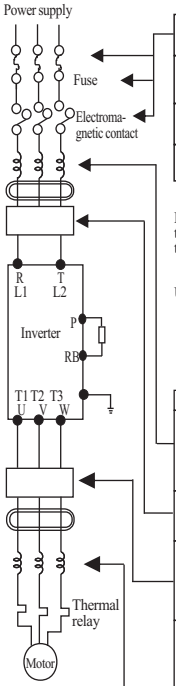
Note6) Do not short circuit the terminals H-L of the control circuit.

Note7) Do not short circuit the terminals H-OI of the control circuit.

6.3 Application wiring apparatus & options

Determination of wire and Fuse size

Motor Output (kw)	Application Inverter Model	Wiring		Applicable equipment	
		Power Lines	Signal Lines	Leakage braker (MCCB)	Magnetic contactor (MC)
0.75	E100-007S	1.25§	(Note1~6) 0.14~ 0.75mm^2 Shielded Wire	HBS-33(10AT)	HMC 10W
1.5	E-100-015S	2.0§		HBS-33(15AT)	HMC 10W
2.2	E-100-022S	2.0§		HBS-33(20AT)	HMC 20W



► Standard Apparatus(3-phase input reference)

Motor output(kw)	Inverter model (N50 Series)	Wiring		Applicable equipment
		Power lines	Signal lines	Fuse(class H) rated 600V
0.75	E-100-007S	1.25§	0.14§ i 0.75§ shielded wire	10A
1.5	E-100-015S	2.0§		15A
2.2	E-100-022S			20A

<Note>

Field wiring connection must be made by a UL listed and CSA certified, closed-loop terminal connector sized for the wire gauge involved. Connector must be fixed using the crimp tool specified by the connector manufacturer.

Be sure to consider the capacity of the circuit breaker to be used.

Be sure to use bigger wires for power lines if the distance exceeds 20m.

Use 0.75mm^2 wire for the alarm signal wire.

► Option

Name	Function
Input-side AC reactor for harmonic suppression/power coordination/power improvement	This is useful when harmonic suppression measures must be taken. when the main power voltage unbalance rate exceeds 3% and the main power capacity exceeds 500kVA, or when a sudden power voltage variation occurs. It also helps to improve the power factor.
EMI filter	Reduces the conductive noise on the main power wires generated from the main power supply. Connect to the inverter primary side(input side).
Output-side noise filter	This is installed between the inverter and the motor to reduce noise radiated from the main the control power wiring. It is useful for reducing radio-wave disturbance in a radio or TV set and for preventing malfunction of measuring instruments or sensors.
AC reactor for vibration reduction/thermal relay malfunction prevention	Vibration may increases when driving a general-purpose motor with an inverter as compared with operation on commercial power. Connecting this reactor between the inverter and the motor allows reduction of motor pulsation. When the wirung between the inverter and the motor is 10m or more, inserting the reactor prevents thermal relay malfunction caused by harmonics resulting from inverter switching. A current sensor can be used instead of the thermal relay

Note 1) The applicable equipment is for ENDA standard four pole squirrel cage motor.
Note 2) Be sure to consider the capacity of the circuit breaker to be used.
Note 3) Be sure to use larger wire for power lines if the distance exceeds 20m.
Note 4) Be sure to use an grounding wire same size of power line or similar.
Note 5) Use 0.75mm^2 wire for the alarm signal terminal.
Note 6) Use 0.5mm^2 wire for the control circuit terminal.

Classify the detective current of the earth leakage breaker depending on the total distance between the inverter and the motor.

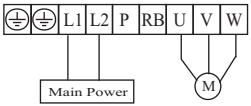
Length	Detective current(mA)
100m and less	30
300m and less	100
800m and less	200

Note1) When using CV wire and metal tube the leakage current is around 30mA/km.
Note2) The leakage current becomes eight times because IV wires have a high dielectric constant. Therefore, use an one class earth leakage breaker according to the above table.

(2) Terminal Function

¢ Main circuit Terminal

Terminal symbol	Terminal name	Function
L1, L2	Main power supply input	Connect the input power supply 220V
U, V, W	Inverter output	Connect the MOTOR
RB, P	External resistor connection	Connect the braking resistor(option)
⏚	Ground	Connect the Die-casting (to prevent electric shock and reduce noise)



¢ Control circuit Terminal

Signal	Terminal symbol	Terminal name	Terminal function
Input signal	5	Forward run command(FW), Reverse run command(RV), multi-speed commands1-4 (CF1-4), 2-stage accel/decel (2CH), Reset(RS), second control function setting (SET), terminal software lock(SFT), unattended start protection(USP), current input selection(AT), jogging operation(JG), External trip(EXT)	contact input : Close : ON (operating) Open : OFF (stop) minimum ON TIME :12ms or more
	4		
	3		
	2		
	1		
	CM1	Common terminal for input or monitor signal	
Monitor signal	FM	Output frequency meter, output current meter, output voltage meter	Analog frequency meter
	CM1	Common terminal for input or monitor signal	

¢ Control circuit Terminal

Signal	Terminal symbol	Terminal name	Terminal function
Frequency command signal	H	Power supply for frequency setting	0¡5VDC
	Note 1 O/OI	Voltage frequency command signal(O)	0¡5VDC, 0¡10VDC(input impedance 700§)
		Current frequency command signal(OI)	4¡20mA(input impedance 25§)
	L	Common terminal for frequency command	
Output signal	11	Intelligent output terminal: run status signal(RUN), frequency arrival signal(FA1) set frequency arrival signal (FA2), overload advance notice signal(OL), PID error deviation signal(OD), alarm signal(AL)	27VDC, 50mA (Maximum)
	CM2	Common terminal for output signal	

NOTE1) There is analog voltage(V)/current(I) selection switch for frequency command..

7. Operation

⚠ DANGER

¡Be sure to turn on the input power supply after closing the front case.
While being energized, be sure not to open the front case.
Otherwise, there is the danger of electric shock

¡Be sure not to operate the switches with wet hands.
Otherwise, there is the danger of electric shock.

¡While the inverter is energized, be sure not to touch the inverter terminals even when the motor is stopped.
Otherwise, there is the danger of electric shock.

¡If the Retry Mode is selected, the motor may suddenly restart during the trip stop. Do not approach the machine(be sure to design the machine so that safety for personnel is secure even if it restarts).
Otherwise, it may cause injury to personnel.

¡If the power supply is cut off for a short period of time, the inverter may restart operation after the power supply recovers if the command to operate is active. If a restart may pose danger to personnel, so be sure to use a lock-out circuit so that it will not restart after power recovery.
Otherwise, it may cause injury to personnel.

¡The stop key is effective only when the stop function is enabled. Be sure to enable the key sepatately from the emergency stop.
Otherwise, it may cause injury to personnel.

¡Arter the operation command is given, if the alarm reset is conducted, it will restart suddenly. Be sure to set the alarm reset after verifying the operation command is off.
Otherwise, it may cause injury to personnel.

¡Be sure not to touch the inside of the energized inverter or to put any conductive object into it.
Otherwise, there is a danger of electric shock and/or fire.

⚠ CAUTION

¡The heat sink fins will have a high temperature. Be careful not to touch them.
Otherwise is the danger of getting burned.

¡The operation of the inverter can be easily changed from low speed to high speed. Be sure check the capability and limitations of the motor and machine before operating the inverter.
Otherwise, there is the danger of injury.

¡If you operate a motor at a frequency higher than the inverter standard default setting 60Hz, be sure to check the motor and machine specifications with the respective manufacturer.
Otherwise, there is the danger of equipment damage.

¡Install a holding brake separately if necessary.
Otherwise, there is the danger of accident.

¡Check the direction of the motor, abnormal motor vibrations, and noise.
Otherwise, there is the danger of equipment damage.

7.1 Before the powerup test

Prior to the test run, check the following

(1) Make sure that the power lines (L1, L2) and output terminals (U, V and W)are connected correctly.
Otherwise, there is a danger of inverter damage

(2)Make sure that there are no mistakes in the signal line connections
Otherwise, it may be incorrect operation of the inverter.

(3) Make sure that the inverter earth terminal is grounded.
Otherwise, there is a danger of electric shock.

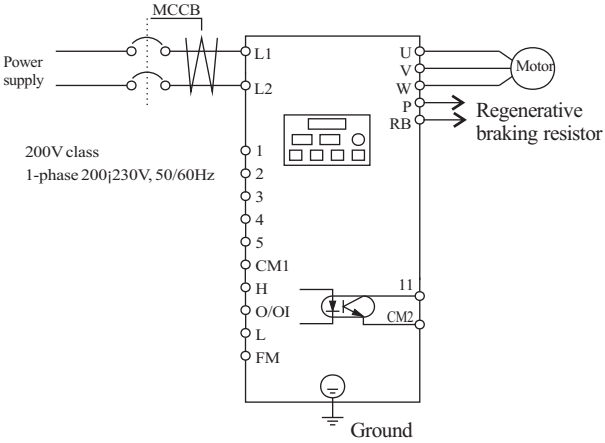
(4) Make sure that terminals other than those specified are not grounded.
Otherwise, it may be incorrect operation of the inverter.

(5) Make sure that there are no short-circuits caused by stay pieces of wire, solderless terminals or other objects left from wiring work.
Also, make sure that no tools have been left behind.
Otherwise, there is a danger of inverter breakage.

(6) Make sure that the output wires are not short-circuited of grounded.
Otherwise. there is a danger of inverter damage.

7.2 Powerup test

The following instructions apply to the power up test.
The operation from the standard operator Frequency setting, Run and stop command are controlled as follows :
Frequency setting select the potentiometer STOP/RUN : select the RUN and STOP key



ACTION (Digital operator control)

(1) Turn On the power supply by turning ON MCCB.
The [POWER] LED will illuminate.
(2) After checking that the potentiometer Enable LED is ON, set the frequency by rotating the potentiometer.
(3) After checking that the RUN Enable LED is ON, press the (RUN) key.
(4) The inverter starts running [RUN] LED is ON.
(5) Monitor the output frequency in the monitor mode d 01
(6) Press the (STOP RESET) key to stop the motor rotation.

Check the following before and during the powerup test.

⚠ CAUTION

¡Is the direction of the motor correct?
Otherwise, there is the danger of equipment damage.

¡Were there any abnormal motor vibrations or noise?
Otherwise, there is the danger of equipment damage.

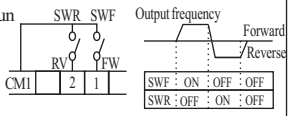
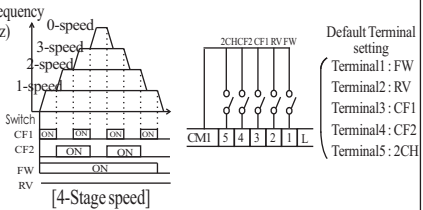
NOTE1) 1. Did the inverter trip during acceleration or deceleration?
2. Were the rpm and frequency meter readings as expected?

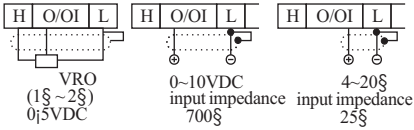
If the over current or over voltage trip is occurred of the power up test, set the acceleration or deceleration time longer.

Factory setting
Maximum frequency : 60Hz Rotation direction : forward run

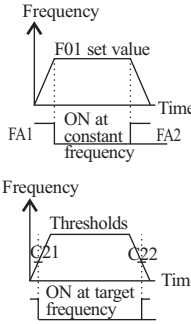
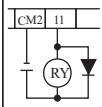
8. Using intelligent terminals

8.1 Intelligent terminal lists

Terminal symbol		Terminal name		Description
Intelligent Input Terminal(1-5)	FW (0)	Forward RUN/STOP terminal		SWF Switch ON (closed):Forward run OFF(open): stop SWR Switch ON (closed):Reverse run OFF(open): stop  When SWF and SWR commands are active at the same time, the inverter stops
	RV (1)	Reverse RUN/STOP terminal		
	CF1 (2)	Multi-speed frequency commanding terminal	1	 [4-Stage speed]
	CF2 (3)		2	
	CF3 (4)		3	
	CF4 (5)		4	
	JG(6)	Jogging		Jogging operation
	2CH (7)	2-stage acceler-ation/deceleration		The acceleration or deceleration time is possible to change considering the system.
	FRS (8)	Free-run stop		The inverter stops the output and the motor enters the free-run state.(coasting)
	EXT (9)	External trip		It is possible to enter the external trip state.
	USP (10)	Unattended start prevention		Restart prevention when the power is turned on in the RUN state.
	SFT (11)	Terminal soft-ware lock		The data of all the parameters and functions except the output frequency is locked.
	AT (12)	Current input selection		The [AT] terminal selects whether the inverter uses the voltage [O] or current [OI] input terminals for external frequency control
	RS (13)	Reset		If the inverter is in Trip Mode, the reset cancels the Trip Mode.

<table>
<tr><th colspan="2">Terminal symbol</th><th>Terminal name</th><th>Description</th></tr>
<tr><td colspan="2">CM1</td><td>Signal source for input</td><td>Common terminal for intelligent input terminals.</td></tr>
<tr><td rowspan="4">Frequency commanding</td><td>H</td><td>Frequency command power terminal</td><td rowspan="4">The External frequency voltage commanding is 0 to 5VDC as a standard.
When the input voltage is 0 to 10VDC, use the parameter A65
 

Note1) If you use current analog input, make sure that the [AT] function is allocated to an intelligent input terminal.</td></tr>
<tr><td rowspan="2">O/OI</td><td>Frequency commanding terminal (voltage commanding)</td></tr>
<tr><td>Frequency commanding terminal (current command)</td></tr>
<tr><td>L</td><td>Frequency command common terminal</td></tr>
<tr><td>Monitor terminal</td><td>FM</td><td>Frequency monitor</td><td>Analog output frequency monitor/ analog output current monitor/ analog output voltage monitor</td></tr>
</table>

<table>
<tr><th colspan="2">Terminal symbol</th><th>Terminal name</th><th>Description</th><th></th></tr>
<tr><td rowspan="6">Intelligent output terminal (11)</td><td>FA1 (1)
FA2 (2)</td><td>Frequency arrival signal</td><td>Frequency arrival [FA1][FA2] signals is indicated when the output frequency accelerates and decelerates to arrive at a constant frequency.
 
</td><td rowspan="7">Output terminal specification
open-collector output
27V DC max
50§ max
 
</td></tr>
<tr><td>RUN (0)</td><td>Run signal</td><td>When the [RUN] signal is selected, the inverter outputs a signal on that terminal when it is in the RUN mode.</td></tr>
<tr><td>OL (3)</td><td>Overload advance notice signal</td><td>When the output current exceeds a preset value, the [OL] terminal signal turns on.</td></tr>
<tr><td>OD (4)</td><td>PID control error deviation signal</td><td>When the PID loop error magnitude the preset value, the [OD] terminal signal turns on.</td></tr>
<tr><td>AL (5)</td><td>Alarm signal</td><td>The inverter alarm signal is active when a fault has occurred.</td></tr>
<tr><td colspan="2">CM 2</td><td>Common terminal</td><td>Common terminal for intelligent output terminal</td></tr>
</table>

8.2 Monitor terminal function
Terminal Name : Monitor terminal [FM] (analog)

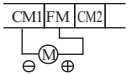
¡The inverter provides an analog output terminal primary for frequency monitoring on terminal [FM] (output frequency, Output current, and output voltage monitor signal).

¡Parameter C17 selects the output signal data.

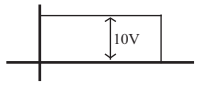
¡When using the analog motor for monitoring, use scale reactor C18 and C19 to adjust the [FM] output so that the maximum frequency in the inverter corresponds to full-scale reading on the motor.

(1) output frequency monitor signal

The [FM] output duty cycle varies with the inverter output frequency. The signal on [FM] reaches full scale when the inverter outputs the maximum frequency.



1§



full-scale maximum T=4§(constant)

Note) This is dedicated indicator, so that it cannot be used as a line speed signal. The indicator accuracy after adjustment is about ¡5% (Depending on the meter, the accuracy may exceed this value)

(2) output current monitor signal

The [FM] output duty cycle varies with the inverter output current to the motor. The signal on [FM] reaches full scale when the inverter output current reaches 200% of the rated inverter current.

The accuracy of the current reaches approximately ¡10%

inverter output current (measured) : Im
monitor display current : Im'
inverter rated current : Ir

$$\frac{Im' - Im}{Ir} \text{ ¡ } 100 \leqq ¡10\%$$

(3) output voltage monitor signal

The [FM] output duty cycle varies with inverter output voltage. The signal on [FM] reaches full scale when the inverter output voltage reaches 100% of the rated inverter voltage.

8.3 Intelligent Input Terminal Function
Forward Run/Stop[FW] and Reverse Run/Stop Command[RV]

¡When you input the Run command via the terminal [FW], the inverter executes the Forward Run command (high) or Stop command(low).

¡When you input the Run command via the terminal [RV], the inverter executes the Reverse Run command(high) or Stop command(low).

Option Code	Terminal Symbol	Function Name	State	Description
0	FW	Forward Run/ Stop	ON	Inverter is in Run Mode, motor runs forward
			OFF	Inverter is in Run Mode, motor stop
1	RV	Reverse Run/ Stop	ON	Inverter is in Run Mode, motor runs reverse
			OFF	Inverter is in Run Mode, motor runs stop

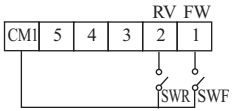
Valid for inputs:	C01,C02,C03,C04,C05
Required setting	A02=01

Notes:

¡When the Forward Run and Reverse Run commands are active at the same time, the inverter enters the Stop Mode.

¡When a terminal associated with either [FW] or [RV] function is configured for normally closed, the motor starts rotation when that terminal is disconnected or otherwise has no input voltage. Set the parameter A02 to 01

Example:



DANGER : If the power is turned on and the Run command is already active, the motor starts rotation and is dangerous! Before turning power on, confirm that Run command is not active.

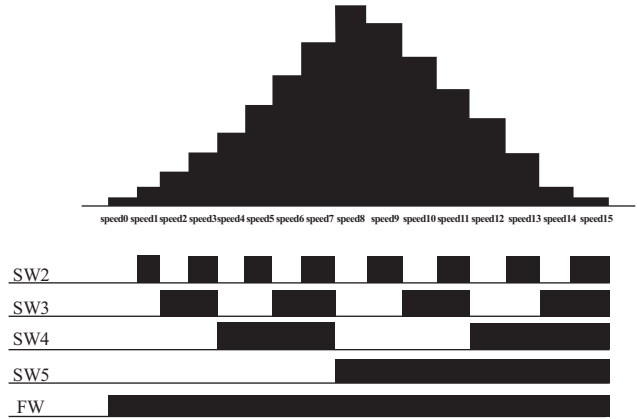
Multi-Speed Select [CF1][CF2][CF3][CF4]

¡The inverter provides storage parameters for up to 16 different target frequencies (speeds) that the motor output uses for steady-state run condition.
These speeds are accessible through programming four of the intelligent terminals as binary-encoded inputs CF1 to CF4 per the table . These can be any of the six inputs, and in any order.
You can use fewer inputs if you need eight or less speeds.

Note : When choosing a subset of speeds to use, always start at the top of the table, and with the least-significant bit: CF1, CF2, etc.

Multi-speed	Control circuit terminal			
	SW5	SW4	SW3	SW2
Speed 0	OFF	OFF	OFF	OFF
Speed 1	OFF	OFF	OFF	ON
Speed 2	OFF	OFF	ON	OFF
Speed 3	OFF	OFF	ON	ON
Speed 4	OFF	ON	OFF	OFF
Speed 5	OFF	ON	OFF	ON
Speed 6	OFF	ON	ON	OFF
Speed 7	OFF	ON	ON	ON
Speed 8	ON	OFF	OFF	OFF
Speed 9	ON	OFF	OFF	ON
Speed 10	ON	OFF	ON	OFF
Speed 11	ON	OFF	ON	ON
Speed 12	ON	ON	OFF	OFF
Speed 13	ON	ON	OFF	ON
Speed 14	ON	ON	ON	OFF
Speed 15	ON	ON	ON	ON

NOTE : Speed 0 is set by the F 01 parameter value.



Multi-speed	Set code	Control circuit terminal					Set value
		SW5	SW4	SW3	SW2	SW1	
		CF4	CF3	CF2	CF1	FW	
Speed 0	F01	OFF	OFF	OFF	OFF	ON	2Hz
Speed 1	A11	OFF	OFF	OFF	ON	ON	5Hz
Speed 2	A12	OFF	OFF	ON	OFF	ON	10Hz
Speed 3	A13	OFF	OFF	ON	ON	ON	15Hz
Speed 4	A14	OFF	ON	OFF	OFF	ON	20Hz
Speed 5	A15	OFF	ON	OFF	ON	ON	30Hz
Speed 6	A16	OFF	ON	ON	OFF	ON	40Hz
Speed 7	A17	OFF	ON	ON	ON	ON	50Hz
Speed 8	A18	ON	OFF	OFF	OFF	ON	60Hz
Speed 9	A19	ON	OFF	OFF	ON	ON	55Hz
Speed 10	A20	ON	OFF	ON	OFF	ON	45Hz
Speed 11	A21	ON	OFF	ON	ON	ON	35Hz
Speed 12	A22	ON	ON	OFF	OFF	ON	25Hz
Speed 13	A23	ON	ON	OFF	ON	ON	15Hz
Speed 14	A24	ON	ON	ON	OFF	ON	5Hz
Speed 15	A25	ON	ON	ON	ON	ON	2Hz

Standard operator option code

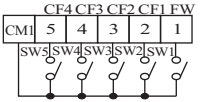
Set the parameter [C01 ¡ C05] to [02 ¡ 05]

Option Code	Terminal Symbol	Function Name	State	Description
Valid for inputs:		C01,C02,C03,C04,C05		Example:
Required setting		F01, A11 to A25		

Notes:

¡When programming the multi-speed setting sure to press the Store key each time and then set the next multi-speed setting. Note that when the key is not pressed, no data will be set.

¡When a multi-speed setting more than 50Hz(60Hz) is to be set, it is necessary to program the maximum frequency A04 high enough to allow that speed.



¡While using the multi-speed capability, you can monitor the current frequency with monitor function F01 during each segment of a multispeed operation. There are two ways to program the speeds into the registers A20 to A25

Programming using the CF switches, Set the speed by following these steps

(1) Turn the Run command off(Stop Mode).

(2) Turn each switch on and set it to Multi-speed n. Display the data section of F01.

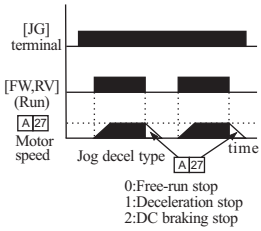
(3) Set an optional output frequency by pressing the ▲ and ▼ keys.

(4) Press the STR key once to store the set frequency. When this occurs, F01 indicates the output frequency of Multi-speed n.

(5) Press the FUNC key once to confirm that the indication is the same as the set frequency.

(6) When you repeat operations in (1) to (4), the frequency of Multi-speed can be set. It can be set also be parameters A11 to A25

Jogging Command [JG]



¡When the terminal [JG] is turned on and the Run command is issued, the inverter outputs the programmed jog frequency to the motor.

¡The frequency for the jogging operation is set by parameter A26.

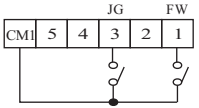
¡Set the value 1 (terminal mode) in A02 (Run command)

¡Since jogging does not use an acceleration ramp, we recommend setting the jogging frequency in A26 to 5Hz or less to prevent tripping.

The type of deceleration used to end a motor jog is selectable by programming function A27 The options are:

0 : Free-run stop (coasting)
1 : Deceleration (normal level) and stop
2 : DC braking and stop

Option Code	Terminal Symbol	Function Name	Input State	Description
6	JG	Jogging	ON	Inverter is in Run Mode, output to motor runs at jog parameter frequency.
			OFF	Inverter is in Stop Mode.
Valid for inputs:		C01,C02,C03,C04,C05		Example:
Required setting		A02, A26, A27		

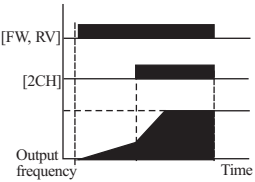


Notes:

¡No jogging operation is performed when the set value of jogging frequency A26 is smaller than the start frequency B10 or the value is 0Hz.

¡Be sure to stop the motor when switching the function [JG] on or off.

Two-stage Acceleration and Deceleration[2CH]

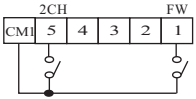


¡When terminal [2CH] is turned on, the inverter changes the rate of acceleration and deceleration from the initial settings F 02 (acceleration time1) and F 03 (deceleration time1) to use the second set of acceleration / deceleration values.

¡When the terminal is turned off, the equipment is turned off, the equipment is returned to the original acceleration and deceleration time (F 02 acceleration time1 and F 03 deceleration time1). Use A 54 (acceleration time2) and A 55 (deceleration time2) to set the second stage acceleration and deceleration time.

¡In the graph shown above, the [2CH] becomes active during the initial acceleration. This causes the inverter to switch form using acceleration 1 (F 02) to acceleration 2 (A 54)

Option Code	Terminal Symbol	Function Name	Input State	Description
7	2CH	Two-stage Acceleration and Deceleration	ON	Frequency output uses 2nd-stage acceleration and deceleration values
			OFF	Frequency output uses the initial acceleration 1 and deceleration 1 values
Valid for inputs		C01,C02,C03,C04,C05		Example:
Required setting		A54, A55, A56		



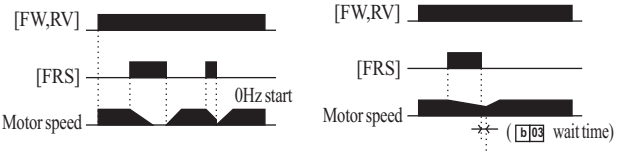
Notes:

¡Function A56 selects the method for second stage acceleration. It must be 00 to select the input terminal method in order for the 2CH terminal assignment to operate.

Free-run stop [FRS]

¡When the terminal [FRS] is turned on, the inverter stops the output and the motor enters the free-run state (coasting). If terminal [FRS] is turned off, the output resumes sending power to the motor if the Run command is still active. The free-run stop feature works with other parameters to provide flexibility in stopping and starting motor rotation.

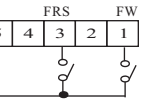
¡In the figure below, parameter B 16 selects whether the inverter resumes operation form 0Hz (left graph) or the current motor rotation speed (right graph) when the [FRS] terminal turns off. The application determines which is the best setting. Parameter B 03 specifies a delay time before resuming operation from a free-run stop. To disable this feature, use a zero delay time.



Option Code	Terminal Symbol	Function Name	Input State	Description
8	FRS	Free-run Stop	ON	Causes output to turn off, allowing motor to free run (coast) to stop
			OFF	Output operates normally, so contorolled deceleration stops motor
Valid for inputs		C01,C02,C03,C04,C05		Example:
Required setting		b03, b16, C07 to C11		

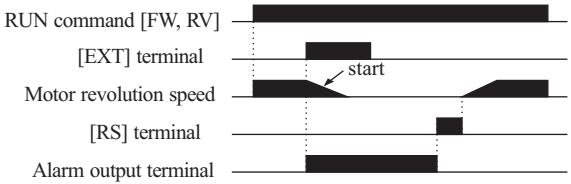
Notes:

¡When you want the [FRS] terminal to be active low(normally closed logic), change the setting (C07 to C12) which corresponds to the input (C01 to C05) that is assigned the [FRS] function



External Trip [EXT]

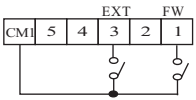
When the terminal [EXT] is turned on, the inverter enters the trip state, indicates error code E 12, and stop the output. This is a general purpose interrupt type feature, and the meaning of the error depends on what you connect to the [EXT] terminal. When the switch between the set terminals [EXT] and [CM1] is turned on, the equipment enters the trip state. Even when the switch to [EXT] is turned off, the inverter remains in the trip state. You must reset the inverter or cycle power to clear the error, returning the inverter to the Stop Mode.



Option Code	Terminal Symbol	Function Name	Input State	Description
9	EXT	External Trip	ON	When assigned input transitions Off to On, inverter latches trip event and displays E12
			OFF	No trip event for On to Off, any recorded trip events remain in history until Reset.
Valid for inputs:		C01,C02,C03,C04,C05		Example:
Required setting		(none)		

Notes:

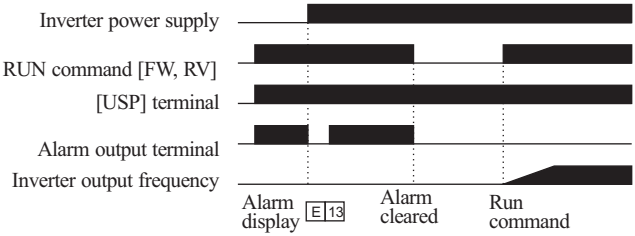
¡If the USP (Unattended Start Protection) feature is in use, the inverter will not automatically restart after cancelling the EXT trip event. In that case, it must receive enter Run command (off-to-on transition)

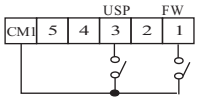


Unattended Start Protection [USP]

If the Run command is already set when power is turned on, the inverter starts running immediately after power up. The Unattended Start Protection (USP) function prevents that automatic start up, so that the inverter will not run without outside intervention. To reset an alarm and restart running, turn the Run commend off or perform a reset operation by the terminal [RS] input or the keypad Stop/reset key.

In the figure below, the [UPS] feature is enabled. When the inverter power turns on, the motor does not start, even though the Run command is already active. Instead, it enters the USP trip state, and displays E13 error code. This forces outside intervention to reset the alarm by turning off the Run command. Then the Run command can turn on again and start the inverter output.



<table>
<tr><th>Option Code</th><th>Terminal Symbol</th><th>Function Name</th><th>Input State</th><th>Description</th></tr>
<tr><td rowspan="2">10</td><td rowspan="2">USP</td><td rowspan="2">Unattended Sart Protection</td><td>ON</td><td>On power up, the inverter will not resume a Run command (mostly used in the Us)</td></tr>
<tr><td>OFF</td><td>On power up, the inverter will not resume a Run command that was active before power loss</td></tr>
<tr><td colspan="2">Valid for inputs:</td><td colspan="2">C01,C02,C03,C04,C05</td><td rowspan="3">Example:
 
</td></tr>
<tr><td colspan="2">Required setting</td><td colspan="2">(none)</td></tr>
<tr><td colspan="4">Notes:
¡Note that when a USP error occurs and it is canceled by a reset from a [RS] terminal input, the inverter restarts running immediately.
¡Even when the trip state is canceled by turning the terminal [RS] on and off after an under voltage protection E09 occurs, the USP function will be performed.
¡When the running command is active immediately after the power is turned on, a USP error will occur. When this function is used, wait for at least three seconds after the power up to generate a Run command.</td></tr>
</table>

Software Lock[SFT]

When the terminal [SFT] is turned on, the data of all the parameters and functions except the output frequency is locked (prohibited from editing). When the data is locked, the keypad keys cannot edit inverter parameters. To edit parameters again, turn off the [SFT] terminal input.
Use parameter B31 to select whether the output frequency is excluded from the lock state or is locked as well.

Option Code	Terminal Symbol	Function Name	Input State	Description
11	SFT	Software Lock	ON	The keypad and remote programming devices are prevented from changing parameters
			OFF	The parameters may be edited and stored
Valid for inputs		C01,C02,C03,C04,C05		
Required setting		B09 (excluded from lock)		

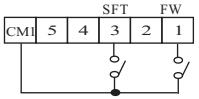
Notes:

¡When the [SFT] terminal is turned on, only the output frequency can be changed.

¡Software lock can be made possible also for the output frequency by b09

¡Software lock by the operator is also possible without [SFT] terminal being used (b09)

Example:



Analog Input Current/Voltage Select [AT]

The [AT] terminal selects whether the inverter uses the voltage [O] or current [OI] input terminals for external frequency control. When the switch between the terminals [AT] and [CM1] is on, it is possible to set the output frequency by applying a current input signal at [OI]-[L]. When the terminal is turned off, the voltage input signal at [O]-[L] is available. Note that you must also set parameter A 01 = 1 to enable the analog terminal set for controlling the inverter frequency, and set the analog voltage(V)/current(I) selection switch exactly.

Option Code	Terminal Symbol	Function Name	Input State	Description
12	AT	Analog Input Voltage/current select	ON	Terminal OI is enabled for current input(uses terminal L for power supply return)
			OFF	Terminal O is enabled for voltage input(uses terminal L for power supply return)

Valid for inputs:	C01,C02,C03,C04,C05
Required setting	A01=01

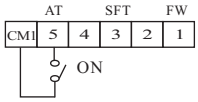
Notes:

¡If the [AT] option is not assigned to any intelligent input terminal, then inverter uses the algebraic sum of both the voltage and current inputs for the frequency command(and A01=01)

¡When using either the analog current and voltage input terminal, make sure that the [AT] function is allocated to an intelligent input terminal.

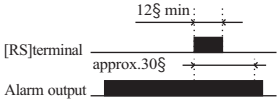
¡Be sure to set the frequency source setting A01=01 to select the analog input terminals.

Example:



Reset Inverter [RS]

The [RS] terminal causes the inverter to execute the reset operation. If the inverter is in Trip Mode, the reset cancels the Trip state. When the switch between the set terminals [RS] and [CM1] is turned on and off, the inverter executes the reset operation. The input timing requirement for [RST] needs a 12 ms pulse width or greater. The alarm output will be cleared within 30 ms after the onset of the Reset command.

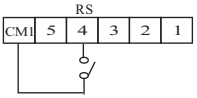


⚠ DANGER

After the Reset command is given and the alarm reset occurs, the motor will restart suddenly if the Run command is already active. Be sure to set the alarm reset after verifying that the Run command is off to prevent injury to personnel.

Option Code	Terminal Symbol	Function Name	Input State	Description
13	RS	Reset Inverter	ON	The motor output is turned off, the Trip Mode is cleared(if it exists), and power up reset is applied
			OFF	Normal power-on operation
Valid for inputs:		C01,C02,C03,C04,C05		
Required setting		(none)		

Example:



Notes:

¡When the control terminal [RS] input is already at power up for more than 4 seconds, the display of the digital operator is E60. However, the inverter has no error.
To clear the digital operator error, turn off the terminal [RS] input and press stop/ reset butt on of the operator.

¡When the [RS] terminal is turned off from on, the Reset command is active.

¡The stop/reset key of the digital operator is valid only when an alarm occurs.

¡Only the normally open contact [NO] can be set for a terminal configured with the [RS] function. The terminal cannot be used in the normally closed contact [NC] state.

¡Even when power is turned off or on, the function of the terminal is the same as that of the reset terminal.

¡The Stop/Reset key on the inverter is only operational for a few seconds after inverter power up when a hand-held remote operator is connected to the inverter.

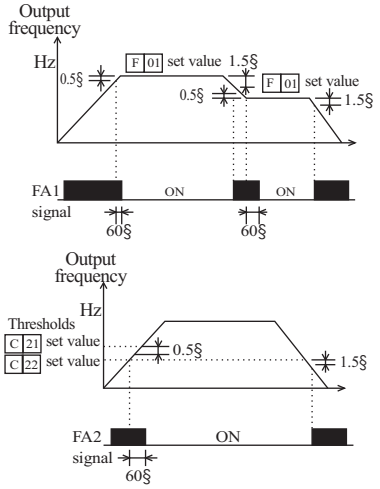
¡If the [RS] terminal is turned on while the motor is running, the motor will be free running(coasting)

8.4 Using intellingent output terminals
(Initial setting is a-contact [NO])

Frequency Arrival Signal [FA1]/[FA2]

Frequency Arrival [FA1] and [FA2] signals indicate when the output frequency accelerates or decelerates to arrive at a constant frequency. Refer to the figure below. Frequency Arrival [FA1](upper graph) turns on when the output frequency gets within 0.5Hz below or 1.5Hz above the target constant frequency.
The timing is modified by a small 60ms delay. Note the active low nature of the signal, due to the open collector output.

Frequency Arrival [FA2] (lower graph) uses thresholds for acceleration and deceleration to provide more timing flexibility than [FA1].
Parameter C21 sets the arrival frequency threshold for acceleration, and parameter C22 sets the thresholds for deceleration. This signal also is active low and has a 60ms delay after the frequency thresholds are crossed.



Option Code	Terminal Symbol	Function Name	Input State	Description
1	FA1	Frequency arrival type 1 signal	ON	when output to motor is at the set frequency
			OFF	when output to motor is off, or in any acceleration or deceleration ramp
2	FA2	Frequency arrival type 2 signal	ON	when output to motor is at or above the set frequency the holds for, even if in acceleration or deceleration ramps
			OFF	when output to motor is off, or during acceleration or deceleration before the respective thresholds are crossed

Valid for inputs:	C13, C21, C22
Required setting	(none)

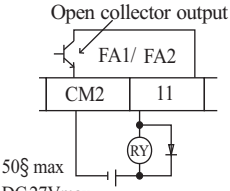
Notes:

¡At the time of acceleration, an arrival signal at a frequency between the set frequency -0.5Hz to +1.5Hz is turned on.

¡At the time of deceleration, an arrival signal at a frequency between the set frequency +0.5Hz to -1.5Hz is turned on.

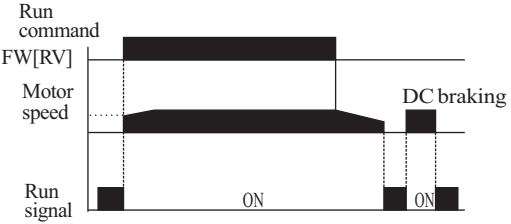
¡The delay time of the output signal is 60ms (nominal).

Example:



Run Signal [RUN]

When the [RUN] signal is selected as an intelligent output terminal, the inverter outputs a signal on that terminal when it is in the Run Mode. The output logic is active low, and is the open collector type (switch to ground)



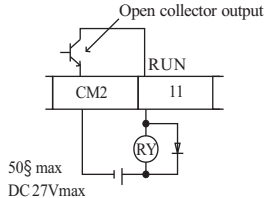
Option Code	Terminal Symbol	Function Name	Input State	Description
0	RUN	Run signal	ON	when inverter is in Run Mode
			OFF	when inverter Stop Mode

Valid for inputs:	C13
Required setting	(none)

Notes:

¡The inverter outputs the [RUN] signal whenever the inverter output exceeds the start frequency . The start frequency is the initial inverter output frequency when it turns on.

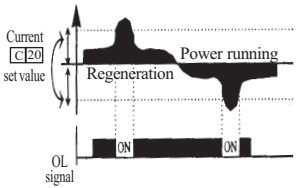
Example:



NOTE : The example circuit in the table above drives a relay coil. Note the use of a diode to prevent the negative-going turn-off spike generated by the coil from damaging the inverter's output transistor.

Overload Advance Notice Signal [OL]

When the output current exceeds a preset value, the [OL] terminal signal turns on. The parameter C20 sets the overload threshold. The overload detection circuit operates during powered motor operation and during regenerative braking. The output circuits use open-collector transistors, and are active low.



Option Code	Terminal Symbol	Function Name	Input State	Description
3	OL	Overload advance notice signal	ON	when output current is more than the set threshold for the overload signal
			OFF	when output current is less than the set threshold for the overload signal

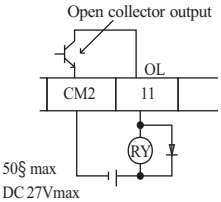
Valid for inputs	C13, C20
Required setting	none

Notes:

¡The default value is 100%. To change the level from the default, set C20 (overload level).

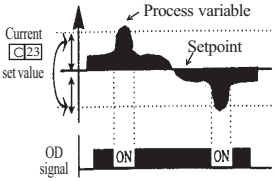
¡The accuracy of this function is the same as the function of the output current monitor on the [FM] terminal

Example:



Output Deviation for PID Control [OD]

The PID loop error is defined as the magnitude(absolute value) of the difference between the Set point (target value) and the process Variable (actual value). When the error magnitude exceeds the press value for C23, the [OD] terminal signal turns on. Refer to the PID loop operation.

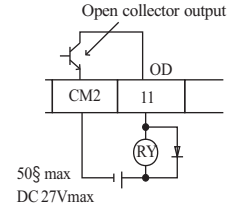


Option Code	Terminal Symbol	Function Name	Input State	Description
4	OD	Output deviation for PID control	ON	when PID error is more than the set threshold for the deviation signal
			OFF	when PID error is less than the set threshold for the deviation signal
Valid for inputs:		C13, C23		Example:
Required setting		none		

Notes:

¡The default difference value is set to 10%. To change the value, change parameter C23 (deviation level).

Example:



NOTE : The example circuit in the table above drives a relay coil. Note the use of a diode to prevent the negative-going turn-off spike generated by the coil from damaging the inverter's output transistor.

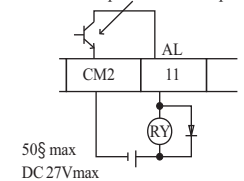
Alarm Signal output [AL]

The Inverter alarm signal is active when a fault has occurred and it is in the Trip Mode. When the fault is cleared the alarm signal becomes inactive.

Option Code	Terminal Symbol	Function Name	Input State	Description
5	AL	Alarm signal	ON	When an alarm signal has occurred and has not been cleared
			OFF	When no alarm has occurred since the last clearing of alarm(s)

Valid for inputs:	C13
Required setting	none

Example: Open collector output



Notes:

¡When the alarm output is set to normally closed [NC], a time delay occurs until the contact is closed when the power is turned on. Therefore, when the alarm contact output is to be used, set a delay of about 2 seconds when the power is turned on.

¡Terminals 11 is open collector outputs,

¡When the inverter power supply is turned off, the alarm signal output is valid as long as the external control circuit has power.

¡The signal output has the delay time(300ms nominal) from the fault alarm output.

¡Output terminal 11 is a contact a.
In case of contact b, set up C15.

8.5 Sensorless Vector Control

Function description

The E-100 inverter has a built-in auto-tuning algorithm. The E-100 inverter can be possible to do high-starting torque and high-precision operation.
Also, the settings have a second set of parameters for a second motor.
The required torque characteristic or speed control characteristic may not be maintained in case that the inverter capacity is move than twice the capacity of the motor in use .

Function setting method

Select the parameter A31 to 2 (sensorless vector control).
Parameter H03 and H04 select motor capacity and poles (4-poles).
Parameter H02 selects which data(standard data, auto-tuning data) of motor constants you want the inverter to use.

8.6 Auto-tuning

Function description

The auto-tuning procedure automatically sets the motor parameter related to sensorless vector control. Since sensorless vector control needs motor parameter, the standard motor parameters have been set at the factory. Therefore, when an inverter exclusive-use motor is used or when a motor of any other manufacture is drive, the motor parameter is detected by auto-tuning because the parameters are not matched.

Function setting

Follow the steps below to auto-tune the inverter, finally set the parameter H01.

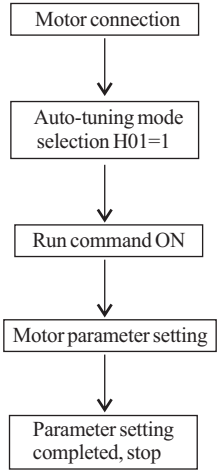
F02, F03 setting : Set the time the range that over-current or over-voltage trip event not occurs.
Set the same as setting F02.

H03 setting : Set the motor rating.

{ 1 : 007SF
2 : 015SF
3 : 022SF }

H04 setting : set the motor poles
A01 setting : set the frequency command source to 0 (potentiometer)
A03 setting : set the base frequency(60Hz)
F01 setting : set the operation frequency except 0hz (by the potentiometer)
A53 setting : select output voltage for motor.
A33 setting : set DC braking setting to 0(disable).
H01 setting : select the auto-tuning mode (1).
After setting above parameters, press the RUN key on the standard operator.

Auto-tuning method



End display

auto-tuning process completed: --oU

auto-tuning process failed : Err

Note) The motor parameter of E-100 is standard data of ENDA standard 4-poles motor. At the sensorless vector control when using different poles motor, operates by using auto-tuning data as a motor parameter.

Setting Method

(1) Digital panel

No	Name	Setting range	Description
H01	auto-tuning mode selection	0/1	0 : auto-tuning OFF 1 : auto-tuning ON
H02	motor data setting	0/1	0 : standard data 1 : auto-tuning data
H03	motor capacity	1¡3	1 : 007SF 2 : 015SF 3 : 022SF
H04	motor poles	2/4/6/8	Unit : pole
H06/H11	motor resistor R1	0.001-30.00	Unit : ¥
H07/H12	motor resistor R2	0.001-20.00	Unit : ¥
H08/H13	Motor inductance	0.01-999.9	Unit : mH
H09/H14	Transient inductance	0.01-100.0	Unit : mH
H10/H15	No-load current	0.1-100.0	Unit : A

The data of H11 to H15 is auto-tuning data.

Remark

1. If satisfactory performance through auto-tuning cannot be fully obtained, please adjust the motor constants for the observed symptoms according to the table below.

Operation status	Symptom	Adjustment	Parameter
Powered running (status with a accelerating torque)	When low frequency (a few Hz) torque is insufficient.	Slowly increase the motor constant R1 in relation to auto-tuning data within 1 to 1.2 times R1.	H06/H11
	When the speed deviation is negative.	Slowly increase the motor constant R2 in relation to auto-tuning data within 1 to 1.2 times R2.	H07/H12
	When the speed deviation is positive	Slowly decrease the motor constant R2 in relation to auto-tuning data within 0.8 to 1 times R2.	H07/H12
	When over current prote ction is operated at injection of load	Slowly increase the motor constant IO in relation to auto-tuning data within 1 to 1.2 times IO.	H10/H15
Regeneration (status with a decelerating torque)	When low frequency (a few Hz) torque is insufficient.	Slowly increase the motor constant R1 in relation to auto-tuning data within 1 to 1.2 times R1.	H06/H11
		Slowly increase the motor constant IO in relation to auto-tuning data within 1 to 1.2 times IO.	H10/H15
		Decrease the carrier frequency.	b11

2. If the inverter capacity is more than twice the capacity of the motor in use, the inverter may not achieve its full performance specifications.
3. Running multiple motor under sensorless vector control is not available.
4. When DC braking is enabled, the motor constant will not be accurately set. Therefore, disable DC braking before starting the auto-tuning procedure.
5. The motor will rotate up to 80% of base frequency : make sure that acceleration or deceleration is not operated. If then, decrease the manual torque boost setting value.
6. Be sure if motor is in standstill before you carry out an auto-tuning. Auto-tuning data carried out when motor is still running may be not correct.
7. If the auto-tuning procedure is interrupted by the stop command, the auto-tuning constants may be stored in the inverter. It will be necessary to store the inverters factory defaults setting.

9. Operating the inverter

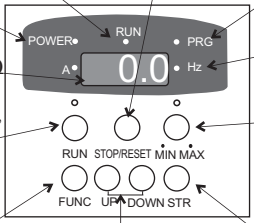
9.1 Identifying the parts

RUN LED
on when the inverter outputs the PWM voltage and operating command is ready

STOP/RESET key
This key is used for stopping the motor or resetting errors. (When either operator or terminal is selected, this key works. If the extension function b 15 is used, this function is void)

POWER LED
On when the control powerinput to inverter is on

PRG LED
This LED is on when the inverter is ready for parameter editing.



Display part (LED display)
This part display frequency, motor current, motor rotation speed, alarm history, and setting value.

Hz/A LED
Display units Hertz/Ampere LEDs.

Potentiometer
set the inverter output frequency.(be operated only when the ramp is ON)

RUN key
Press this key to run the motor. The Run enable LED must be terminal operation

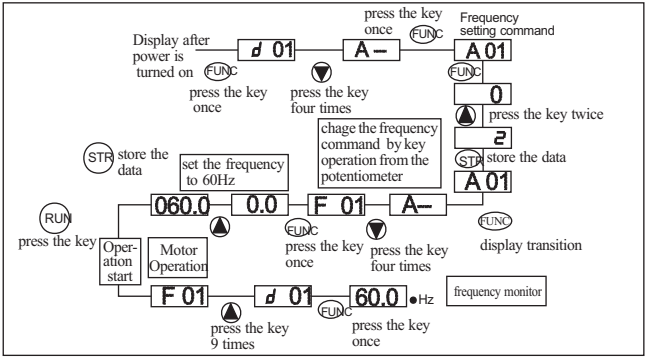
FUNCTION key
This key is used for changing parameter and command

UP/ DOWN key
This key is used to change data and increase or decrease the frequency.

STORE KEY
Press the store key to write the data and setting value to the memory

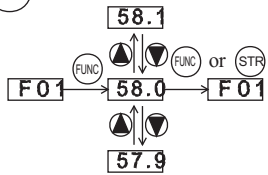
9.2 Operation procedure

(Example that the frequency is set from potentiometer to the standard operator and the equipment starts running)

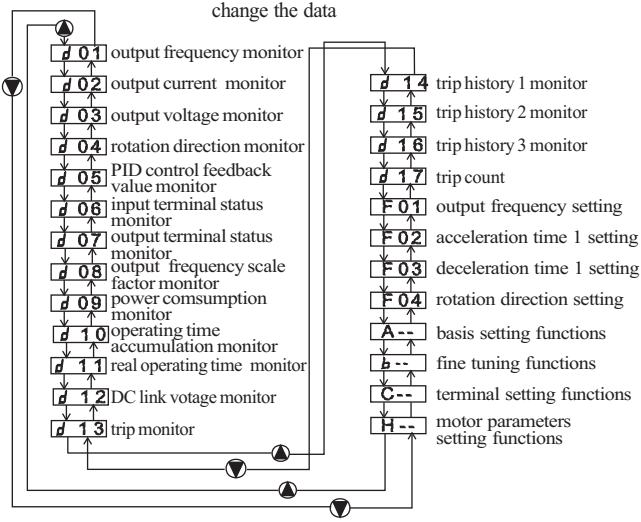


9.3 Key Description

FUNC [FUNCTION key]¤¤This key allows the selection of commands and memorises parameters. When the key is pressed once in the state of, the extension function code selection state is set.



▲ ▼ [UP/DOWN key]¤¤The key are used to select the command and change the data



RUN [RUN key]¤¤This key starts the run.

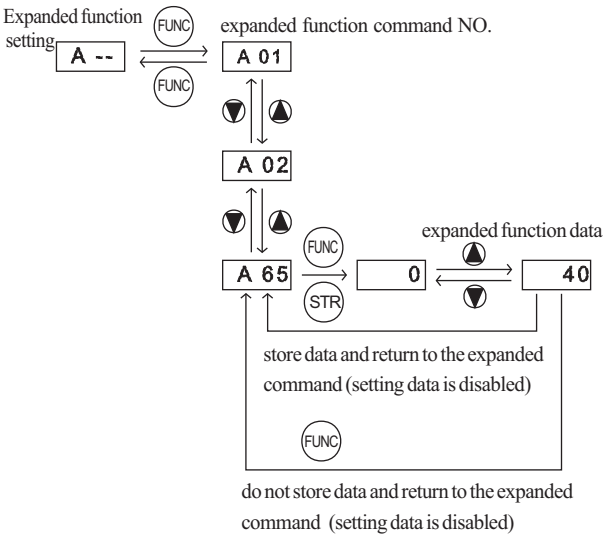
The set value of F 04 determines a forward run or a reverse run.

STOP RESET [STOP/RESET key]¤¤This key stops the run

When a trip occurs, this key becomes the reset key.

9.4 Expanded function mode navigational map

Using the ▲ / ▼ key to enter the expanded function mode, select expanded function command NO. in A-- b-- C-- and H-- mode.

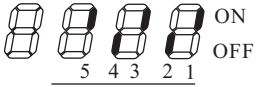
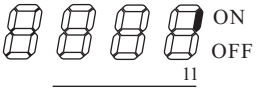


Display description:

When the inverter is turned on, the output frequency monitor display appears.

Function List

Parameter Monitoring Functions

Func-code	Name	Description
d01	Output frequency monitor	Real-time display of output frequency to motor, from 0.00 to 400.0 Hz, "Hz" LED ON
d02	Output current monitor	Real-time display of output current to motor, from 0.0 to 99.9A, "A" LED ON.
d03	Output voltage monitor	Real-time display of output voltage to motor
d04	Rotation direction monitor	Three different indications: "F"..... Forward Run "□"... Stop "r"..... Reverse Run
d05	PID feedback monitor	Displays the scaled PID process variable (feedback) value (A50 is scale factor)
d06	Intelligent input terminal status	Displays the state of the intelligent input terminals: 
d07	Intelligent output terminal status	Displays the state of the intelligent output terminals: 
d08	Scaled output frequency monitor	Displays the output frequency scaled by the constant in b14. Scale factor(b14) x frequency data

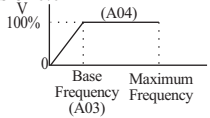
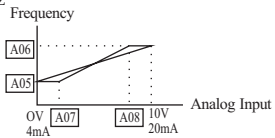
Func-code	Name	Description
d09	Power consumption monitor	Displays the power consumption at inverter starting (W)
d10	Operating time accumulation monitor(hour)	Inverter operating accumulation time(0¡9999)
d11	Real operating time monitor (minute)	Inverter real operating time (0¡59)
d12	DC link voltage	Displays the inverter DC link voltage(V)
d13	Trip event monitor	Displays the current trip event ¡Display method Alarm reason ¡ press the UP key Output frequency at alarm event ¡ press the UP/DOWN key Output current at alarm event ¡ press the UP/DOWN key DC link voltage at alarm event ¡ press the FUNC key "d13" display ¡No trip event — —
d14	Trip history 1 monitor	Displays the previous first trip event
d15	Trip history 2 monitor	Displays the previous secound trip event
d16	Trip history 3 monitor	Displays the previous third trip event
d17	Trip count	Displays the trip accumulation count

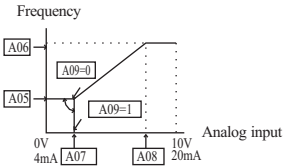
Basic Function Mode

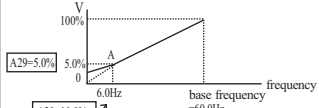
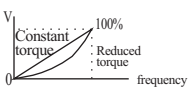
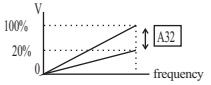
Func-code	Name	Description	Run-time Edit	Defaults
F01	Output frequency setting	Standard default target frequency that determines constant motor that determines constant motor speed. setting range is 0.00 to 400.0Hz (1) frequency setting from UP/DOWN key of digital operator. (2) Multi-step speed By combining frequency reference and intelligent input terminal ON/OFF, up to 16 step of speed can be set. (3) Remote operator, control terminal input (O-L, OI-L). Frequency reference by the local potentiometer can be monitored.	¡	volume setting value
F02	Acceleration time1 setting	Standard default acceleration, setting range is 0.1 to 3000sec. minimum setting range 0.1¡999.9 ----- by 0.1sec 1000¡3000 ----- by 1sec	¡	10.0sec
F03	Deceleration time 1 setting	Standard default deceleration, 2nd motor. minimum setting range 0.1¡999.9 ----- by 0.1sec 1000¡3000 ----- by 1sec	¡	10.0sec
F04	Rotation direction setting	Two options: select codes: 0... Forward run 1... Reverse run	¡	0
A--	Extended function of A group setting	Basic setting functions setting range : A01¡A65	—	—
b--	Extended function of b group setting	Fine tuning functions Setting range :b01¡b17	—	—
C--	Extended function of C group setting	Terminal setting functions Setting range :C01¡C23	—	—
H--	Extended function of H group setting	Sensorless vector setting functions Setting range :H01¡H15	—	—

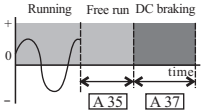
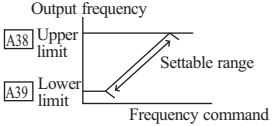
Note) If you set the carrier frequency less than 2kHz, acceleration / deceleration time delays approximately 500msec.

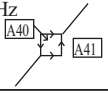
Expanded Function Mode of A Group

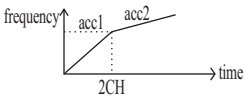
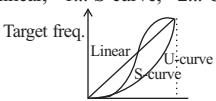
Func-code	Name	Description	Run-time Edit	Defaults
Basic parameter settings				
A01	Frequency commanding (Multi-speed commanding method)	Four options: select codes: 0.... Keypad potentiometer 1.... Control circuit terminal input 2.... Standard operator 3.... Remote operator(communication)	i	0
A02	Run commanding	Set the method of run commanding: 0.... Standard operator 1.... Control circuit terminal input 2.... Remote operator(communication)	i	0
A03	Base frequency setting	Settable from 0 to maximum frequency in units of 0.01Hz 	i	60.00Hz
A04	Maximum frequency setting	Settable from the base frequency [A03] up to 400Hz in units of 0.1 Hz.	i	60.00Hz
Analog Input Settings				
A05	External frequency setting start	Start frequency provided when analog input is 0V (4mA) can be set in units of 0.01Hz setting range is 0 to 400 Hz 	i	0.00Hz
A06	External frequency setting end	End frequency provided when analog input is 10V(20mA) can be set in units of 0.01Hz. setting range is 0 to 400Hz	i	0.00Hz

Func-code	Name	Description	Run-time Edit	Defaults
A07	External frequency start rate setting	The starting point(offset) for the active analog input range(0¡10V, 4mA¡20mA) setting range is 0 to 100% in units of 0.1%	¡	0.0%
A08	External frequency end rate setting	The ending point(offset) for the active analog input range(0¡10V, 4mA¡20mA) setting range is 0 to 100% in units of 0.1%	¡	100.0%
A09	External frequency start pattern setting	Two options: select codes:  0.... start at start frequency 1.... start at 0Hz	¡	0
A10	External frequency sampling setting	Range n = 1 to 8, where n = number of samples for average	¡	4
Multi-speed Frequncy Setting				
A11 —· A25	Multi-speed frequency setting	¡Defines the first speed of a multi-speed profile, range is 0 to 400Hz in units of 0.01Hz. ¡Setting range is 1-speed(A11) to 15-speed(A25). ¡Speed0:volume setting value	¡	speed1:5Hz speed2:10Hz speed3:15Hz speed4:20Hz speed5:30Hz speed6:40Hz speed7:50Hz speed8:60Hz etc. 0Hz
A26	Jogging frequency setting	Defines limited speed for jog, range is 0.5 to 10.00Hz in units of 0.01Hz. The jogging frequency is provided safety during manual operation.	¡	0.50Hz
A27	Jogging stop operation selection	Define how end of jog stops the motor: three options: 0.... Free-run stop 1.... Deceleration stop(depending on deceleration time) 2.... DC braking stop(necessarg to set DC braking)	¡	0

Func-code	Name	Description	Run-time Edit	Defaults
V/F Characteristics				
A28	Torque boost mode selection	Two options: 0.... Manual torque boost 1.... Automatic torque boost	¡	0
A29	Manual torque boost setting	Can boost starting torque between 0 and 100% above normal V/F curve, from 0 to 1/2 base frequency Be aware that excessive torgue boost can cause motor damage and inverter trip. 	¡	5.0%
A30	Manual torque boost frequency setting	Sets the frequency of the V/F breakpoint A in graph for torque boost	¡	10.0%
A31	V/F characteristic curve selection	Two available V/F curves: three select codes: 0... Constant torque 1... Reduced torque(reduction of the 1.7th power) 2... Sensorless vector control 	¡	2
A32	V/F gain setting	Sets output voltage gain of the inverter from 20 to 100% 	¡	100.0%

Func-code	Name	Description	Run-time Edit	Defaults
DC Braking Settings				
A33	DC braking function selection	Sets two options for DC braking 0.... Disable 1.... Enable	¡	0
A34	DC braking frequency setting	The frequency at which DC braking occurs, range is 0.0 to 10.0 Hz in units of 0.01Hz	¡	0.50Hz
A35	DC braking output delay time setting	The delay from the end of Run command to start of DC braking (motor free runs until DC braking begins). Setting range is 0.0 to 5.0sec in units of 0.1set. 	¡	0.0sec
A36	DC braking force setting	Applied level of DC braking force, settable from 0 to 50% in units of 0.1%	¡	10.0%
A37	DC braking time setting	Sets the duration for DC braking, range is 0.0 to 10.0 seconds in units of 0.1sec.	¡	0.0sec
Frequency-related Functions				
A38	Frequency upper limit setting	Sets a limit on output frequency less than the maximum frequency(A04). Range is 0.00 to 400.0Hz in units of 0.01Hz. 	¡	0.00Hz
A39	Frequency lower limit setting	Sets a limit on output frequency greater than zero. Range is 0.00 to 400.0Hz in units of 0.01Hz	¡	0.00Hz
A40 A42 A44	Jump(center) frequency setting	Up to 3 output frequencies can be defined for the output to jump past to avoid motor resonances(center frequency) range is 0.00 to 400.0Hz in units of 0.01Hz.	¡	0.00Hz

Func-code	Name	Description	Run-time Edit	Defaults
A41 A43 A45	Jump(hysteresis) frequency width setting	Defines the distance from the center frequency at which the jump around occurs. Range is 0.00 to 10.00Hz in units of 0.01Hz 	i	0.00Hz
PID Control(Note1)				
A46	PID Function selection	Enables PID function, two option codes: 0.... PID control disable 1.... PID control enable	i	0
A47	PID P (proportional) gain setting	Proportional gain has a range of 0.1 to 100 in units of 0.1.	i	10.0%
A48	PID I (integral) gain setting	Integral time constant has a range of 0.0 to 100.0 seconds in units of 0.1	i	10.0sec
A49	PID D(derivative) gain setting	Derivative gain has a range of 0.0 to 100 .0 seconds in units of 0.1	i	0.0sec
A50	PID scale factor setting	PID scale factor (multiplier), range of 0.1 to 1000 in units of 0.1	i	100
A51	Feed-back method setting	Selects source of PID, option codes: 0.... "OI" terminal(current in put) 1.... "O" terminal(voltage in put)	i	1
Automatic Voltage Regulation (AVR) Function				
A52	AVR function selection	Automatic (output) voltage regulation, selects from three type of AVR functions, three option codes: 0... Constant ON 1... Constant OFF 2... OFF during deceleration	i	0
A53	Motor input voltage setting	200V class inverter settings: .... 200/220/230/240 400V class inverter settings: 380/400/415/440/460	i	220V

Func-code	Name	Description	Run-time Edit	Defaults
Second Acceleration and Deceleration Functions				
A54	Second acceleration time setting	Duration of 2nd segment of acceleration, range is 0.1 to 3000 sec. Second acceleration can be set by the [2CH] terminal input or frequeny transition setting	i	10.0sec 30.0sec
A55	Second deceleration time setting	Duration of 2nd segment of deceleration, motor, range is 0.1 to 3000 sec. Second acceleration can be set by the [2CH] terminal input or frequeny transition setting	i	10.0sec 30.0sec
A56	Two stage acce1/dece1 switching method selection	Two options for switching from 1st to 2nd accel/decel: 0.... 2CH input from terminal 1.... transition frequency 	i	0
A57	Acc1 to Acc2 frequency transition point	Output frequency at which Accel 1 switches to Acce1 2, range is 0.00 to 400.0Hz in units of 0.01Hz.	i	0.00Hz
A58	Decl to Dec2 frequency transition point	Output frequency at which Decel 1 switches to Dece1 2, range is 0.00 to 400.0Hz in units of 0.01Hz.		0.00Hz
A59	Acceleration curve selection	Set the characteristic curve of Acc1 and Acc2, two options: 0... linear, 1... S-curve, 2... U-curve 	i	0
A60	Deceleration curve setting	Set the characteristic curve of dec1 and dec2, two options: 0... linear, 1... S-curve, 2... U-curve	i	0

Func-code	Name	Description	Run-time Edit	Defaults
A61	Input voltage offset setting	Set the voltage offset for external analog signal input input signal adjustment	¡	0.0
A62	Input voltage Gain setting	Set the voltage gain for external analog signal input signal adjustment	¡	100.0
A63	Input current offset setting	Set the current offset for external analog signal input signal adjustment	¡	0
A64	Input current Gain setting	Set the current gain for external analog signal input signal adjustment	¡	100.0
A65	External voltage input frequency selection	Set the input power supply for external voltage input frequency 0:5V input 1:10V input	¡	1

Note 1) PID feedback control

The PID(Proportional, Integral, Differential) control functions can apply to controlling of fan, the air (water) amount of pump, etc., as well as controlling of pressure within a fixed value.

[Input method of target value signal and feedback signal]

Set the reference signal according to the frequency setting method or the internal level.

Set the feedback signal according to the analog voltage input (0 to 10V) or analog current input (4 to 20mA).

If both input signal (target value and feedback value) set the same terminal, PID control is not available.

To use analog current [OI-L] for the target value, set the [AT] terminal to ON.

[PID gain adjustment]

If the response is not stabilized in a PID control operation, adjust the gains as follows according to the symptom of the inverter.

¡The change of controlled variable is slow even when the target value is changed.
¡ Increase P gain [A47]

¡The change of controlled variable is fast, but not stable.
¡ Decrease P gain[A47]

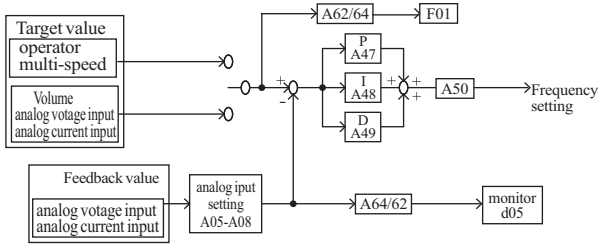
¡It is difficult to make the target value match with the controlled variable.
¡ Decrease I gain [A48]

¡Both the target value and the controlled variable are not stable.
¡ Increase I gain [A48]

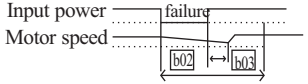
¡The response is slow even when the P gain is increased.
¡ Increase D gain[A49]

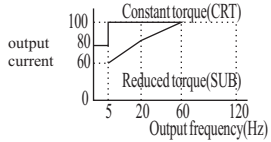
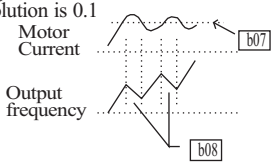
¡The response is not stabilized due to oscillation even when the P gain is increased.
¡ Decrease D gain[A49]

The figure below is a more detailed diagram of the PID control.



Expanded Function mode of B Group

Func-code	Name	Description	Run-time Edit	Defaults
Restart Mode				
b01	Selection of restart mode	Select inverter restart method, four option codes: 0.... Alarm output after trip, no automatic restart 1.... Restart at 0Hz 2.... Resume operation after frequency matching 3.... Resume previous freq. after freq. matching, then decelerate to stop and display trip info. ¡Restart trip is overcurrent, overvoltage and under voltage. ¡Overcurrent and over voltage trip restart up to 3 times, under voltage trip restart up to 10time.	¡	0
b02	Allowable instantaneous power failure time setting	The amount of time a power input under voltage can occur without tripping the power failure alarm. Range is 0.3 to 1.0 sec. If under-voltage exists longer than this time, the inverter trips, even if the restart mode is selected.	¡	1.0sec
b03	Reclosing stand by after instantaneous power failure recovered	Time delay after under-voltage condition goes away, before the inverter runs motor again. Range is 0.3 to 3.0 seconds. 	¡	1.0sec

Func-code	Name	Description	Run-time Edit	Defaults
Electronic Thermal Overload Alarm Setting				
b04	Electronic thermal level setting	Set a level between 20% and 120% for the rated inverter current. setting range- 0.2¡ (inverter rated current)¡1.2¡ (inverter rated current).	¡	100.0%
b05	Electronic thermal characteristic, selection	Select from two curves, option codes: 0....(SUB) reduced torque characteristic 1....(CRT) constant torque characteristic 	¡	1
Overload Restriction				
b06	Overload overvoltage restriction mode selection	Select overload or overvoltage restriction modes 0.... Overload, overvoltage restriction mode OFF 1.... Only overload restriction mode ON 2.... Only overvoltage restriction mode ON 3.... Overload overvoltage restriction mode ON	¡	3
b07	Overload restriction level setting	Sets the level for overload restriction, between 20% and 200% of the rated current of the inverter, setting range- 0.2¡ (inverter rated current)¡2.0¡ (inverter rated current).	¡	150.0%
b08	Overload restriction constant setting	Set the deceleration rate when inverter detects overload, range is 0.1 to 10.0 and resolution is 0.1 	¡	0.1sec

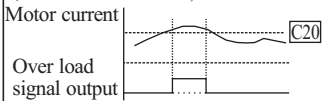
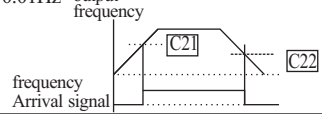
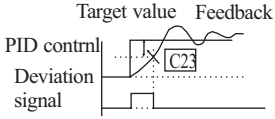
Func-code	Name	Description	Run-time Edit	Defaults
Software Lock Mode				
b09	Software lock mode selection	Prevents parameter changes, in four options, option codes: 0.... All parameters except b09 are locked when SFT from terminal is on 1.... All parameters except b09 and output frequency F01 are locked when SFT from terminal is ON 2.... All parameters except b09 are locked 3.... All parameters except b09 and output frequency F01 setting are locked	i	0
Other Function				
b10	Start frequency adjustment	Sets the starting frequency for the inverter output, range is 0.50 to 10.00Hz in units of 0.01Hz	i	0.50Hz
b11	Carrier frequency setting	Sets the PWM carrier frequency, range is 0.5 to 16.0kHz in units of 0.1kHz.	i	15.0kHz
b12	Initialization mode(parameters or trip history)	Select the type of initialization to occur, two option codes: 0.... Trip history clear 1.... Parameter initialization	i	0
b13	Country code for initialization	Select default parameter values for country on initialization, three options, option codes: 0.... Korea version 1.... Europe version 2.... US version	i	0
b14	Frequency scalar conversion factor	Specify a constant to scale the displayed frequency for [d08] monitor, range is 0.01 to 99.9 in units of 0.01	o	1.00
b15	STOP key validity during terminal operation	Select whether the STOP key on the keypad is enabled, two option codes: 0.... stop enabled 1.... stop disabled	i	0
b16	Resume on FRS cancellation mode	Select how the inverter resumes operation when the free-run stop (FRS) is cancelled, two options: 0... Restart from 0Hz 1....Restart from frequency detected from real speed of motor 2.....Free run stop	i	0
b17	Communication number	Sets the communication number for communication, range is 1 to 32	i	1

Expanded Function Mode of C Group

Func-code	Name	Description	Run-time Edit	Defaults
Input TerminalFunction				
C01	Intellingent Input terminal 1 setting	Select function for terminal 1 <code> 0: Forward run command(FW) 1: Reverse run command(RV) 2: 1st multi-speed command(CF1) 3: 2nd multi-speed command(CF2) 4: 3rd multi-speed command(CF3) 5: 4th multi-speed command(CF4) 6: Jogging operation command(JG) 7: 2-stage acceleration/deceleration command(2CH) 8: free-run stop command(FRS) 9:external trip(EXT) 10:unattended start protection(USP) 11:software lock function(SFT) 12:analog input current/voltage selection signal(AT) 13:reset(RS)	¡	0
C02	Intellingent Input terminal 2 setting	Select function for terminal 2 <code>-see C01 parameter	¡	1
C03	Intellingent Input terminal 3 setting	Select function for terminal 3 <code>-see C01 parameter	¡	2
C04	Intellingent Input terminal 4 setting	Select function for terminal 4 <code>-see C01 parameter	¡	12
C05	Intellingent Input terminal 5 setting	Select function for terminal 5 <code>-see C01 parameter	¡	13
C07	Input Terminal 1 a/b contact setting (NO/NC)	Select logic convention, two option codes: 0.... normally open [NO] 1.... normally closed [NC]	¡	0
C08	Input Terminal 2 a/b contact setting (NO/NC)	Select logic convention, two option codes: 0.... normally open [NO] 1.... normally closed [NC]	¡	0
C09	Input Terminal 3 a/b contact setting (NO/NC)	Select logic convention, two option codes: 0.... normally open [NO] 1.... normally closed [NC]	¡	0

Func-code	Name	Description	Run-time Edit	Defaults
C10	Input Terminal 4 a/b contact setting (NO/NC)	Select logic convention, two option codes: 0.... normally open [NO] 1.... normally closed [NC]	¡	0
C11	Input Terminal 5 a/b contact setting (NO/NC)	Select logic convention, two option codes: 0.... normally open [NO] 1.... normally closed [NC]	¡	0

Output Terminal Function				
C13	Intellingent output terminal 11 setting	Select function for terminal 11 <code> 0... RUN(Run signal) 1.... FA1(Frequency arrival signal: command arrival) 2.... FA2(Frequency arrival signal: setting frequency or more) 3.... OL(Overload advance notice signal) 4.... OD(Output deviation for PID control) 5.... AL(Alarm signal)	¡	5
C15	Output Terminal 11 a/b contact setting	Select logic convention, two option codes: 0.... normally open [NO] 1.... normally closed [NC]	¡	0
C17	Montor signal selection	Select function for terminal FM, 3 options 0.... output frequency monitor 1.... output current monitor 2.... output voltage monitor	¡	0

Func-code	Name	Description	Run-time Edit	Defaults
Output Terminal state setting				
C18	Analog meter gain adjustment	Range is 0 to 250, resolution is 1	¡	100.0%
C19	Analog meter offset adjustment	Range is -3.0 to 10.0% resolution is 0.1	¡	0.0%
Output Terminal related function				
C20	Overload advance notice signal level setting	Sets the overload signal level between 50% and 200% resolution is 0.1%. 0.5x(Inverter rated current) ¡2.0x (Inverter rated current) 	¡	100%
C21	Acceleration arrival signal frequency setting	Sets the frequency arrival setting threshold for the output frequency during acceleration. Setting range is 0.0 to A04, resolution is 0.01Hz 	¡	0.00Hz
C22	Deceleration arrival signal frequency setting	Sets the frequency arrival setting threshold for the output frequency during deceleration, setting range is 0.00 to 400.0Hz resolution is 0.01Hz	¡	0.00Hz
C23	PID deviation level setting	Sets the allowable PID loop error magnitude. Setting range is 0.0 to 100%, resolution is 0.01% 	¡	10.0%

Expanded Function mode of H Group

Func-code	Name	Description	Run-time Edit	Defaults
Sensorless Vector Control				
H01	Auto-tuning mode selection	Two States for auto-tuning function, option codes: 0.... Auto-tuning OFF 1.... Auto-tuning ON	¡	0
H02	Motor data selection	Two selections, option codes: 0.... Use standard motor data 1.... Use auto-tuning data	¡	0
H03	Motor capacity	Ten selections: 1 : 007SF 2 : 015SF 3 : 022SF	¡	specified by the capacity of each inverter
H04	Motor poles setting	Four selections: 2/4/6/8	¡	4poles
H05	Motor rated current	The setting depend on the inverter capacity	¡	–
H06	Motor Resistance R1	Range is 0.001 to 30.00 ohm	¡	–
H07	Motor Resistance R2	Range is 0.001 to 20.00 ohm	¡	–
H08	Motor Inductance L	Range is 0.1 to 999.9 mH	¡	–
H09	Transien Inductance	Range is 0.01 to 100.0 mH	¡	–
H10	Motor constant IO	Range is 0.1 to 100.0A	¡	–
H11	Motor Resistance R1	Auto-tuning data setting range is 0.001 to 30.00 ohms	¡	–
H12	Motor Resistance R2	Auto-tuning data setting range is 0.001 to 20.00 ohms	¡	–
H13	Motor Inductance L	Auto-tuning data setting range is 0.1 to 999.9mH	¡	–
H14	Transien Inductance	Auto-tuning data setting range is 0.01 to 100.0 mH	¡	–
H15	Motor constant IO auto-tuning data	Auto-tuning data setting range is 0.1 to 100.0A	¡	–

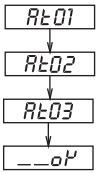
The data of H11 to H15 is auto-tuning data.

10. Protective function

The various functions are provided for the protection of the inverter itself, but they may also protection function when the inverter breaks down.

Name	Cause(s)	Error Code
Overcurrent protection	When the inverter output current exceeds the rated current by more than approximately 200% during the motor locked or reduced in speed. Protection circuit activates, halting inverter output.	E04
Overload protection (Electronic thermal) Regenerative	When the inverter output current causes the motor to overload, the electronic thermal trip in the inverter cuts off the inverter output.	E05
Over voltage protection	If regenerative energy from the motor or the main power supply voltage is high, the protective circuit activates to cut off the inverter output when the voltage of DC link exceeds the specification	E07
Communication error	The inverter output is cut off when communication in the inverter has an error to external noise, excessive temperature rise, or other factor	E60
Under-voltage protection	When input voltage drops below the low-voltage detection level, the control circuit does not function normally. So when the input voltage is below the specification, the inverter output is cut off.	E09
Output short-circuit	The inverter output was short-circuited. This condition causes excessive current for the inverter, so the inverter output is turned off.	E34
USP error	The USP error is indicated when the power is turned on with the inverter in RUN state. (Enabled when the USP function selected)	E13
EEPROM error	The inverter output is cut off when EEPROM in the inverter has an error due to external noise, excessive temperature rise, or other factor	E08
External trip	When the external equipment or unit has an error, the inverter receives the corresponding signal and cuts off the output.	E12
Temperature trip	When the temperature in the main circuit increases due to cooling fan stop, the inverter output is cut off.(only for the model type with cooling fan)	E21

Other display

Contents	Display
It is displayed when initialization of data is processing (It is not displayed when initialization of history is processing.)	
It is displayed when Copy function is operated by the remote operator.	
There is no data available (Trip history, PID feedback data)	
The auto-tuning operation terminates normally.	

11. Troubleshooting Tips

Symptom/condition		Probable Cause	Countermeasure
The motor will not run.	The inverter outputs U,V and W are not supplying voltage.	¡Is the frequency command source A01 parameter setting correct? ¡Is the Run command source A02 parameter setting correct?	¡Make sure the parameter A01 setting correct? ¡Make sure the parameter A02 setting correct?
		¡Is power being supplied to terminals L1, L2 If so, the power lamp should be on.	¡Check terminals L1, L2 then U, V, and W ¡Turn on the power supply or check fuses.
		¡Is there an error code E¡¡ displayed?	¡Press the Func key and determine the error type. Then clear the error(Reset).
		¡Are the signals to the intelligent input terminals correct? ¡Is the Run Command active? ¡Is the[FW] terminal (or [RV] connected to CM1(via switch, etc.)	¡Verify the terminal functions for C01-C06 are correct. ¡Turn on Run Command ¡Supply 24V to [FW] or [RV] terminal, if configured. (Terminal mode selection)
		¡Has the frequency setting for F01 been set greater than zero? ¡Are the control circuit terminals H, O, and L connected to the potentiometer?	¡Set the parameter for F01 to a safe, non-zero value. ¡If the potentiometer is the frequency setting surce, verify voltage at"O" £0V
		¡Is the RS(reset) function or FRS(free-run stop) function on?	¡Turn off the command(s)
	Inverter outputs U,V,W are supplying voltage.	¡Is the motor load too heavy? ¡Is the motor locked?	¡Reduce load, and test the motor independently.

Symptom/condition	Probable Cause	Countermeasure
The direction of the motor is reversed	¡Are the connections of output terminal U, V, and W correct? ¡Is the phase sequence of the motor forward or reverse with respect to U, V, and W?	¡Make connections according to the phase sequence of the motor. In general: FWD=U-V-W, and REV=U-W-V.
	¡Are the control terminals [FW] and [RV]wired correctly? ¡Is parameter F04 properly set?	¡Use terminal [FW] for [RV] is reverse. ¡Set motor direction in F04.
The motor speed will not reach the target frequency (desired speed)	¡If using the analog input, is the current or voltage at"O" or"OI"?	¡Check the wiring ¡Check the potentiometer or signal generating device.
	¡Is the load too heavy?	¡Reduce the load. ¡Heavy loads activate the overload restriction feature (reduces output as needed)
The rotation is unstable	¡Is the load fluctuation too great? ¡Is the supply voltage unstable? ¡Is the problem occurring at a particular frequency?	¡Increase the motor capacity (both inverter and motor) ¡Fix power supply problem. ¡Change the output frequency slightly, or use the jump frequency setting to skip the problem frequency.
The RPM of the motor does not match the inverter output frequency setting	¡Is the maximum frequency setting A04 correct? ¡Does the monitor function d01 display the expected output frequency?	¡Verify the V/F settings match motor specifications ¡Make sure all scaling is properly set

Symptom/condition		Probable Cause	Countermeasure
Inverter data is not correct	No down-loads have occurred.	¡Was power turned off after a parameter edit but before pressing the store key?	¡Edit the data and press the store key once
		¡Edits to data are permanently stored at power down. Was the time from power off to power on less than six seconds?	¡Wait six seconds or more before turning power off after editing data.
A param-eter will not change after an edit (reve-rts to old setting)	The frequency setting will not change. Run/Stop does not operate.	¡Was the standard operator mode and terminal mode changed correctly?	¡Make sure the setting mode of [A01], [A02] is changed
	True for certain param-eters	¡Is the inverter in run mode? some parameters cannot be edited during run mode	¡Put inverter in stop mode (press the stop/reset key) Then edit the parameter.
	True for all param-eters	¡If you're using the[SET] intelligent input selection [b09] is the [SFT] ¡Is switch 4(located on the back of the remote operator copy unit) on?	¡Change the state of the SFT input, and check the b09 parameter (b09=0) ¡Turn the switch off

Precautions for data setting

When changing any set data and pressing (STR) key to store the data, keep the equipment un-operated for 6 seconds or more after the selected method is executed. When any key is pressed, or the reset operation is performed, or the power is turned off within 6 seconds, correct data may not be set.

12. Maintenance and Inspection

Please read following safety messages before troubleshooting or performing maintenance on the inverter and motor system.

⚠ DANGER

¡Wait at least five(5) minutes after turning off the input power supply before performing maintenance of an inspection. Otherwise, there is the danger of electric shock.

¡Make sure that only qualified personnel will perform maintenance, inspection, and part replacement. (Before starting to work, remove any metallic objects from your person(wristwatch, bracelet, etc.)) Be sure to use tools with insulated handles. Otherwise, there is a danger of electric shock and/or injury to personnel.

12.1 General Precautions and Notes

¡Always keep the unit clean so that dust of other foreign matter does not enter the inverter.

¡Take special care in regard to breaking wires of making connection mistakes.

¡Firmly connect terminals and connectors.

¡Keep electronic equipment away from moisture and oil. Dust, steel filings and other foreign matter can damage insulation, causing unexpected accidents, so take special care.

¡When removing connectors, never pull the wires(wires for the cooling fan and logic P.C. board.) Otherwise, there is danger of fire due to wire breakage and/or injury to personnel.

12.2 Inspection Items

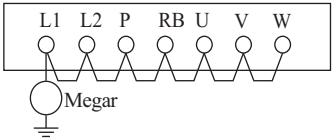
This chapter provides instructions or checklists for these inspection items:

¡Daily inspection

¡Periodic inspection(approximately once a year)

¡Insulation resistance test(approximately once two years)

Conduct the insulation resistance test by short circuiting the terminals as shown below.



Never test the withstand voltage on the inverter. The inverter has a surge protector between the main circuit terminals and the chassis ground.

Spare parts

We recommend that you stock spare parts to reduce down time, which include:

Part description	Symbol	Quanity		Note
		Used	Spare	
Cooling fan	FAN	1	1	007S~022S
Case		1	1	Main case

Monthly and Yearly Inspection Chart

Item Inspected		Check for...	Inspection Cyelc		Inspection Method	Criteria
			Month	Year		
Overall	Ambient environment	Extreme temperatures & humidity	¡		Thermometer, hygrometer	Ambient temperature between -10 to 40¡, non-condensing
	Major devices	Abnormal vibration noise	¡		Visual and aural	Stable environment for electronic controls
	Power supply insulation	Voltage tolerance	¡		Digital volt meter, measure between inverter terminals R, S, T	200V class: 200 to 230V 50/60Hz
Main circuit	Ground Insulation	Adequate resistance		¡	Digital volt meter, GND to terminals	500V class Megohm meter
	Mounting	No loose screws		¡	Torque wrench	M3: 0.5¡0.6Nm M4: 0.98¡1.3Nm M5: 1.5.¡2.0Nm
	Components	Overheating		¡	Thermal trip events	No trip events
	Housing	Dirt, dust		¡	Visual	Vacuum dust and dirt
	Terminal block	Secure connections		¡	Visual	No abnormalities
	Smoothing capacitor	Leaking swelling	¡		Visual	No abnormalities
	Relay(s)	Chattering		¡	Aural	Single click when switching On or Off
	Resistors	Cracks or discoloring		¡	Visual	Use Ohm meter to check braking resistors
	Cooling fan	Noise	¡		Power down, manually rotate	Rotation must be smooth
		Dust	¡			Vacuum to clean
Control circuit	Overall	No odor, discoloring corrosion		¡	Visual	No abnormalities
	Capacitor	No leaks or deformation	¡		Visual	Undistorted appearance
Display	LEDs	Legibility	¡		Visual	All LED segments work

Note1: The life of a capacitor is affected by the ambient temperature,

Note2: The inverter must be cleaned periodically. If dust accumulates on the fan and heat sink, it can cause overheating of the inverter.

12.3 General Inverter Electrical Measurements

The following table specifies how to measure key system electrical parameters. The diagrams on the next page show inverter-motor systems the location of measurement points for these parameters.

Parameter	Circuit location of measurement	Measuring instrument	Notes	Reference Value
Supply voltage E_1	L1-L2 E1	Moving-coil type voltmeter or rectifier type voltmeter	Fundamental wave effective value	Commercial supply voltage (200V class) 200~220V 50Hz 200-230V 60Hz (400V class) 380-415V 50Hz 400-460v 60Hz
Supply current I_1	R S T Current (I_1) (I_2)	Moving-coil type Ammeter	Total effective value	
Supply power W_1	L1-L2 W_1	Electronic type wattmeter	Total effective value	
Supply power factor Pf_1	$Pf_1 = \frac{W_1}{E_1 \times I_1} \times 100(\%)$			
Output voltage E_0	U-V, V-W, W-U (E_U) (E_V) (E_W)	Rectifier type voltmeter	Total effective value	
Output current I_0	U, V, W current (I_U) (I_V) (I_W)	Moving-coil type Ammeter	Total effective value	
Output power W_0	U-V, V-W (W_{01})+(W_{02})	Electronic type wattmeter	Total effectivevalue	
Output power factor Pf_0	Calculate the output power factor from the output voltage E_0, output current I_0, and output power W_0 $Pf_0 = \frac{W_0}{\sqrt{3} \times E_0 \times I_0} \times 100(\%)$			

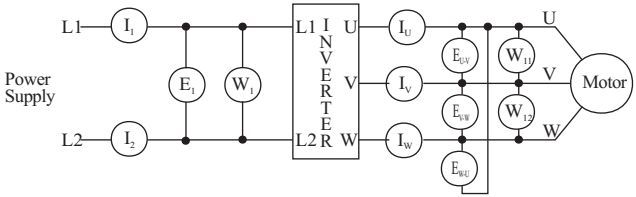
Note 1: Use a meter indicating a fundamental wave effective value for voltage, and meters indicating total effective values for current and power.

Note 2: The inverter output has a PWM waveform, and low frequencies may cause erroneous readings. However, the measuring instruments and methods listed above provide comparably accurate results.

Note 3: A general-purpose digital volt meter (DVM) is not usually suitable to measure a PWM waveform(not pure sinusoid)

The figures below show measurement locations for voltage, current, and power measurements listed in the table on the previous page. The voltage to be measured is the fundamental wave effective voltage. The power to be measured is the total effective power.

Three-phase measurement diagram



13. Option

13.1 Dynamic Braking Resistor

In case of Light load

	Motor capacity (kW)	Dynamic braking resistance (200V class)		Dynamic braking resistance (400V class)	
		R	WATTAGE	R	WATTAGE
1	1.5 KW	50 §	0.2 kW	180 §	0.3 kW
2	2.2 KW	50 §	0.3 kW	100 §	0.3 kW

In case of Heavy load

	Motor capacity (kW)	Dynamic braking resistance (200V class)		Dynamic braking resistance (400V class)	
		R	WATTAGE	R	WATTAGE
1	1.5 KW	50 §	0.3 kW	180 §	0.3 kW
2	2.2 KW	35 §	0.6 kW	100 §	0.6 kW

13.2 Digital Operator(DOP 1)

Digital operator is economical remote operator DOP1 can control inverter parameter and operating command. DOP1 has

Digital operator(DOP1) can control inverter prameter and operating commands. Digital operator(DOP1) is economical remote operator, has a 4-digit 7 segment LED, so it is possible not only operate inverter but also display inverter status.

£ Specification£

Item		Description
External Dimension		67.5(H) ¡ 64.9(W) ¡ 36.1(D)
Display	7-segment LED	4-digit 7 segment LED
	Monitor lamp	7(POWER/RUN/PRG/Hz/A/RUN key/ Volume LED)
Keypad		7(RUN/STOP(RESET)/FUNC/UP/DOWN/ STR/Volume)
Communication Method		RS485 (Moduler connection)
Function		Inverter operation & watching
Connection Cable length		1.5m, 3m

Identifying the parts

RUN LED
on when the inverter outputs the PWM voltage and operating command is ready

STOP/RESET key
This key is used for stopping the motor or resetting errors. (When either operator or terminal is selected, this key works. If the extension function b 15 is used, this function is void)

POWER LED
On when the control powerinput to inverter is on

PRG LED
This LED is on when the inverter is ready for parameter editing.

Display part (LED display)
This part display frequency, motor current, motor rotation speed, alarm history, and setting value.

Hz/A LED
Display units Hertz/Ampere LEDs.

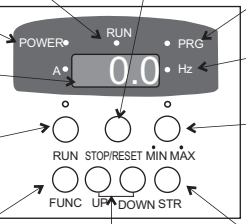
Potentiometer
set the inverter output frequency.(be operated only when the ramp is ON)

RUN key
Press this key to run the motor. The Run enable LED must be terminal operation

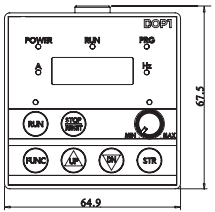
STORE KEY
Press the store key to write the data and setting value to the memory

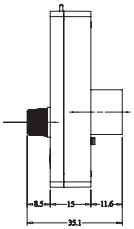
FUNCTION key
This key is used for changing parameter and command

UP/ DOWN key
This key is used to change data and increase of decrease the frequency.



External dimension

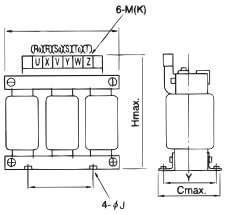




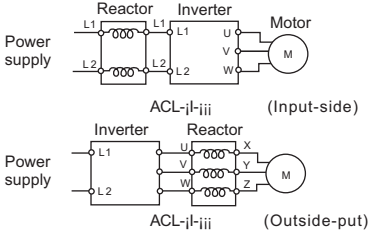
13.3 Input-side and Output-side AC reactor

External Diagram

(Figure 1)

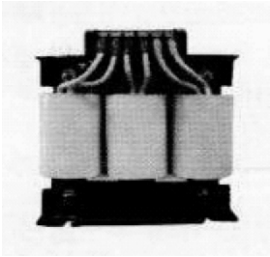


Connection Diagram



Input - side AC reactor

This is useful when harmonic suppression measures must be taken, when the main power voltage Unbalance rate exceeds 3% and the main power capacity exceeds 500KVA, or when a sudden power voltage variation occurs, It also helps to improve the power factor



ACL– L I – 2.5

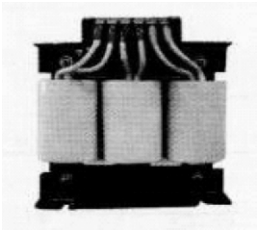
L:3- phase 200V
H:3- phase 400V

Input-side

Inverter output capacity (KVA)

Output-side reactor

Vibration may increase when driving a general purpose motor with an inverter as compared with commercial power operation. Connecting this reactor between the inverter and the motor allows reduction of motor pulsation. When the cable between the inverter and the motor is 10m or more inserting the reactor prevents thermal relay malfunction caused by harmonics resulting from inverter switching. A current sensor can be used instead of the thermal relay.



ACL– L – 2.5

L:3- phase 200V
H:3- phase 400V

Inverter output capacity (KW)

AC reactor size for improve power factor input side

Voltage	Capacity (KW)	Type	Wiring Dimension(mm)					J	Standard	Weight (Kg)	Figure No.
			A	C	H	X	T				
200V	0.75	ACL-LI-1.5	110	80	110	40	52	6	4	1.85	1
	1.5	ACL-LI-2.5	130	90	130	50	67	6	4	3.0	1
	2.2	ACL-LI-3.5	130	95	130	50	70	6	4	3.4	1
	3.7	ACL-LI-5.5	130	100	130	50	72	6	4	3.9	1
	5.5	ACL-LI-7.5	130	115	130	50	90	6	4	5.2	1
	7.5	ACL-LI-11	180	120	190	60	80	6	4	8.6	1

AC reactor size for improve power factor output side

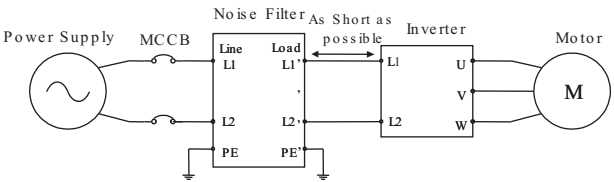
Voltage	Capacity (KW)	Type	Wiring Dimension(mm)					J	Standard	Weight (Kg)	Figure No.
			A	C	H	X	T				
200V	0.4	ACL-L-0.4	110	90	110	40	65	6	4	2.7	1
	0.7	ACL-L-0.75	130	105	130	50	80	6	4	4.2	1
	1.5	ACL-L-1.5	160	100	160	80	75	6	4	6.6	1
	2.2	ACL-L-2.2	180	110	190	90	90	6	4	11.5	1
	3.7	ACL-L-3.7	220	110	210	125	90	6	4	14.8	1
	5.5	ACL-L-5.5	220	110	220	125	90	6	5.3	15.0	2
	7.5	ACL-L-7.5	220	130	220	120	112	7	6.7	22.0	2

13.4 Noise filter

Reduces the conductive noise on the main power wires generated from the main power supply. Connect to the inverter primary side (input side).

Connection of the noise filter

Install a noise filter as shown in figure below. The noise filter must be installed as close as possible to the inverter and its wiring distance minimized. In addition, the primary and secondary wirings of the noise filter must not be close to each other or cross each other



Outlook of the noise filter

Specification of the noise filter

Class	Applicable inverter type	Model	Rated Current	Rated Voltage	External Dimension[mm] (W¡H¡D)
200V	007S~022S	FM-220S	2A	250V	84¡50¡39*24

14. RS485 Communication

The communication between inverter and external controller is doing by RS485 using modular connector in cling to inverter controller.

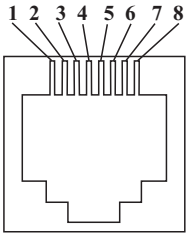
- Relation code -

Function code	Minimum	Maximum	Initial Value	Unit	Description
b 17	1	32	1	-	Setting the communication number
A 01	0	3	0	-	3: Communication
A 02	0	2	0	-	2: Digital operator

- Communication formula -

Item	Description	Remark
Interface	RS485	
Communication method	Half duplex	
Communication speed	9600	Fixing
Communication code	Binary code	
Data bits	8	Fixing
Parity	No.	Fixing
Stop bit	1	Fixing
Starting method	External request	Inverter is only slave part.
Wait time	10¡1000ms	
Connection type	1 : N (Max32)	
Error check	Frame / CRC / CMD / MAXREQ / parameter	Communication number is selected at b17

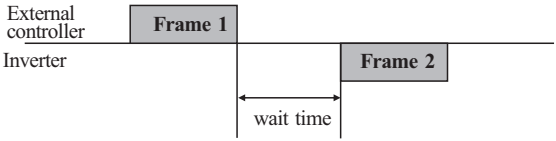
RS485 port specification



Pin number	Description
1	
2	
3	Transmit/Receive+side
4	
5	
6	Transmit/Receive-side
7	24V
8	24V GND

Communication sequence

The communication sequence is as follows:



Frame start : Frame start is recognized by signal line data transmitted.

Frame completion : Frame completion is recognized by no data during correspond 4, 5-character time.

Frame 1: Transmit from external controller to inverter.

Frame 2: Indication reflects from inverter to external controller.

Communication frame type and form

External controller transmit frame

Number	Command	Parameter	Parameter Count	CRC Hi	CRC Lo

	Description	Data size	Specifications
Communication number	Inverter Communication number	1 byte	1 ¡ 32
Command	Frame type	1 byte	0 x 03
Parameter	Parameter	2 byte	1st byte : Group 2nd byte : Index
Parameter number	Request parameter number	2 byte	1st byte : 0¡00 2nd byte : N(0¡01¡0¡08)
CRC Hi	-	1 byte	Higher 8bit of 16bit CRC
CRC Lo	-	1 byte	Lower 8bit of 16bit CRC

Inverter response frame

Communication number	Order	Byte number	Data 1	.....	Data N	CRC Hi	CRC Lo

	Description	Data size	Specifications
Communication number	Inverter Communication number	1 byte	1 ¡ 32
Command	Frame type	1 byte	0 x 03
Byte Number	Data Byte number	1 byte	Request parameter number x 2
Data 1	Parameter 1	2 byte	Parameter value
Data N	Parameter N	2 byte	Nth parameter value
CRC Hi	-	1 byte	Higher 8bit of 16bit CRC
CRC Lo	-	1 byte	Lower 8bit of 16bit CRC

¡Frame Size = 5+Request parameter number¡2

External transmit frame

Communication number	Order	Parameter	Data	CRC Hi	CRC Lo

	Description	Data size	Specifications
Communication number	Target Inverter Communication number	1 byte	1 ¡ 32
Command	Frame type	1 byte	0 x 06
Parameter	Parameter	2 byte	1st byte : Group 2nd byte : Index (Note1)
Data	Data	2 byte	Setting value(Note 2)
CRC Hi	-	1 byte	Higher 8bit of 16bit CRC
CRC Lo	-	1 byte	Lower 8bit of 16bit CRC

Inverter response frame

Communication number	Order	Parameter	Data	CRC Hi	CRC Lo

	Description	Data size	Specifications
Communication number	Target Inverter Communication number	1 byte	1 ¡ 32
Command	Frame type	1 byte	0 x 06
Parameter	Parameter	2 byte	1st byte : Group 2nd byte : Index (Note1)
Data	Data	2 byte	Setting value is response(Note 4)
CRC Hi	-	1 byte	Higher 8bit of 16bit CRC
CRC Lo	-	1 byte	Lower 8bit of 16bit CRC

(Note1) Parameter setting

Basic parameter

1st byte : Each group is setting.

Group	1st byte	Group	2nd byte
d	0x01	C	0x05
F	0x02	S	0x06
A	0x03	H	0x07
d	0x04		

2nd byte : Parameter number setting.

Ex) The case of A60 parameter reading or writing

1st byte : 0x03

2nd byte : 0x3C

Trip information

Trip information is 4 parameter.(output frequency, output current, DC link voltage at trip occurs)

	Trip information	Previous first trip	Previous second trip	Previous third trip	Trip count
1st trip	0x01	0x01	0x01	0x01	0x01
2nd trip	0x0D	0x11	0x15	0x19	0x1D

Trip information items

Trip data	Trip contents	Trip data	Trip contents
1	Over current trip	7	Electric thermal trip
2	Over voltage trip	8	Outside trip
3	Under voltage trip	9	EEROM trouble
4	Arm short trip	10	Communication trouble
5	Reserved	11	USP trip
6	Inverter over heat trip	12	GF trip

(Note2) Data value setting

Data value is transmitted except decimal point.

Ex1) Output frequency

Parameter value	Communication data	Conversion hexadecimal
60.00Hz	6000	1st byte : 0x17 2nd byte : 0x70

Ex2) acc/dec time

Parameter value	Communication data	Conversion hexadecimal
10.00sec	100	1st byte : 0x00 2nd byte : 0x64

Note3) Special parameter

Run command

parameter

1st byte : 0x00

2nd byte : 0x02

setting data

1st byte

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Reserved							

2nd byte

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Reserved					RST	REV	RWD

Bit0 : Forward command

Bit1 : Reverse command

Bit2 : Reset command

Frequency command
Parameter
1st byte : 0x00
2nd byte : 0x04
setting data
output frequency *100
Ex) the case of output frequency command is 60.00Hz
Data 6000 transmit
1st byte : 0x17
2nd byte : 0x70

16bit CRC generation

The step of CRC generation is as follows:

1. All of 16-bit register is 1.0xffff
2. The exclusive OR of 16-bit register and 8-bit register.
3. Shift right side 1bit 16-bit register
4. If the result of step 3 is 1, exclusive OR 16-bit register and 0xa001.
5. Execute 8 times step 3 and step 4.
6. Execute step 2¡6 until data completion.
7. Exchange the step 6 result of higher 8bit and lower 8bit.

Ex)
The case of D01 output frequency reading.

Byte 1	Byte 2	Byte 3	Byte 4	Byte 6	Byte 7
Commun-ication number	Command	Parameter		Parameter number	
0x01	0x03	0x01	0x01	0x00	0x01

The sequence of addition Byte(01x01)

BIT١٦-	REGISTER		MSB	Flag
(Exclusive OR)	١١١١	١١١١	١١١١١١١١	
	١٠٠٠٠٠١			
	١١١١	١١١١	١١١١١١١٠	
١Shift	٠١١١	١١١١	١١١١١١١١	
٢Shift	٠٠١١	١١١١	١١١١	١١١١
Polynomial	١٠١٠	٠٠٠٠	٠٠٠٠٠٠٠١	
	١٠٠١	١١١١	١١١١	١١١٠
٣Shift	٠١٠٠	١١١١	١١١١١١١١	
٤Shift	٠٠١٠	٠١١١	١١١١	١١١١
Polynomial	١٠١٠	٠٠٠٠	٠٠٠٠٠٠٠١	
	٠١٠٠	٠١١١	١١١١	١١١٠
٥Shift	١٠٠٠	٠٠١١	١١١١١١١١	
٦Shift	٠٠١٠	٠٠٠١	١١١١	١١١١

Polynomial	1010	0000	0000	0001	
	1000	0001	1111	1110	
Shift 7	0100	0000	1111	1111	
Shift 8	0010	0000	0111	1111	1
Polynomial	1010	0000	0000	0001	
	1000	0000	0111	1110	

Byte1¡6	CRC of operation results
0¡01	0¡807e
0¡03	0¡3364
0¡01	0¡30e1
0¡01	0¡8831
0¡00	0¡d449
0¡01	0¡36d4